APPENDIX F-5: WETLANDS

Executive Summary

The following reports assessment data for wetland resources in the Yazoo Study Area associated with proposed flood risk reduction efforts under evaluation by the U.S. Army Corps of Engineers (USACE) Vicksburg District. The assessment was conducted using a certified model, the Regional Guidebook for Applying the Hydrogeomorphic (HGM) Approach to Assessing Wetland Functions of Selected Regional Wetland Subclasses, Yazoo Basin, Lower Mississippi River Alluvial Valley. The wetlands assessment documented the wetland functions provided by all forested and agricultural areas within the 2-year floodplain of the Yazoo Study Area exhibiting a minimum flood duration of 5.0% of the growing season (corresponding to a 14-day flood hydroperiod) in accordance with existing technical standards for determining wetland hydrology. Conditions of the wetlands identified at the pump station and borrow area were also assessed.

Results are presented for both the No Action Alternative and Proposed Plan. The results aggregate anticipated impacts of project implementation by land cover type and flood duration interval over a 50 year period of analysis. The wetland assessment also details the calculation of compensatory mitigation acreages required to offset the unavoidable impacts to wetland resources and compared results with findings detailed in the 2007 Final Supplement No. 1 to the 1982 Yazoo Area Pump Project Final Environmental Impact Statement (FEIS), hereinafter referred to as the 2007 FSEIS. Implementation of the Proposed Plan will result in a decrease of 11,054 Average Annual Functional Capacity Units (AAFCUs) for indirect project impacts associated with changes in flood duration intervals, requiring establishment of 2,312 acres of reforested compensatory mitigation lands. Direct impacts associated with the project physical footprint (e.g., pump station, borrow areas) will result in a decrease of 444 AAFCUs, requiring

an additional 93 acres of mitigation. The development of 2,700 acres of reforested agricultural lands as a nonstructural component of the project will generate an additional 10,667 AAFCUs over the period of analysis. These activities will result in a net 2.1% increase in wetland functions in the Yazoo Basin under the Proposed Plan. This analysis utilizes data from previously developed successful mitigation projects in the Yazoo Study Area to quantify mitigation trajectories, providing a data-driven approach to assessing both the impacts and associated mitigation requirements.

1 Purpose

The purpose of this appendix is to document wetland conditions within the 2-year floodplain of the Yazoo Backwater Yazoo Study Area that are subject to riverine backwater flooding for a duration of ≥5.0% of the growing season. The assessment includes 1) data on current wetland functional capacities under a No Action Alternative, 2) anticipated conditions under the Proposed Plan, and 3) reports the amount of compensatory mitigation required to offset unavoidable impacts to wetland resources following project implementation. Information regarding the wetland functional benefits of establishing 2,700 acres of reforested agricultural area associated with the nonstructural component of the project are also included, although they are not incorporated into the determination of compensatory mitigation requirements related to impacts to wetland resources.

2 Background

Wetlands are defined as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (Environmental Laboratory 1987).

The subsections below describe the general characteristics of wetlands within the Yazoo Study Area (2.1), evaluate the major sources of wetland hydrology in the region (2.2), discuss advances in assessing wetland functions specifically designed for application in the in the region (2.3), and present data from previously constructed mitigation projects in the area in support of future mitigation efforts (2.4).

2.1 Wetland characteristics in the Yazoo Study Area

The following provides an overview of the wetland characteristics and conditions within the Yazoo Study Area, focusing on the dominant vegetative communities, soil characteristics, and hydrology of the system. This approach aligns with the guidance in USACE (2010) and elsewhere that utilizes three factors (hydrophytic vegetation, hydric soils, and wetland hydrology) to identify and characterize wetlands.

Hydrophytic vegetation has been defined as the community of macrophytes that occurs in areas where inundation or soil saturation is either permanent or of sufficient frequency and duration to influence plant occurrence (Environmental Laboratory 1987). The climax wetland vegetation communities within the Yazoo Study Area are composed of forested ecosystems adapted to soil saturation and flood inundation. Historic logging activities, implementation of flood control projects, the conversion of forested lands to agriculture, and reforestation efforts have altered species composition in the region. The shift in land cover and landuse patterns also resulted in a patchwork of successional forests ranging from early stage (e.g., <10 year old) to mature (>80 year old) forest stands (Smith and Klimas 2002). However, a predominance of hydrophytic vegetation species persists in forested areas in the Yazoo Study Area (Berkowitz 2019). Data collected during the preparation of this report reflect the forest conditions observed in much of the region, providing data from 43 forested study plots in mature stands. Dominant tree species determined using the 50/20 rule described in USACE (2010) included (in order of abundance): *Celtis laevigata* (Sugarberry), *Quercus lyrata* (Overcup Oak), *Fraxinus pennsylvanica* (Green Ash), *Liquidambar styraciflua* (Sweetgum), *Quercus texana* (Nuttall Oak), *Quercus phellos* (Willow Oak), *Carya illinoinensis* (Pecan), *Acer negundo* (Boxelder), *Ulmus Americana* (American Elm), and *Populus deltoides* (Eastern Cottonwood). More frequently inundated areas and depressional features also exhibit *Taxodium distichum* (Bald-Cypress), and *Nyssa aquatica* (Water Tupelo) as dominant hydrophytic vegetation community components. Smith and Klimas (2002) provide additional information about the wetland plant communities in the Yazoo Basin with regard to landform, disturbance, and other factors.

Hydric soils are defined as soils "formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal Register 1994). The parent material deposits on which hydric soils within the Yazoo Study area form are generally composed of alluvium derived from the Mississippi River and its tributaries. These soils represent pedogenically young features characterized by high productivity for forest growth. Agricultural productivity is also high if appropriate drainage can be implemented, and many soils in the area are somewhat poorly to poorly drained, exhibit slopes <2%, and are characterized by seasonal high water tables in their unaltered states. In general, soils in the region exhibit medium to fine soil textures, with fine fractions (including shrink swell clays) commonly dominating backswamp, oxbow lake, and other depressional landscape components. Coarser soil materials may be encountered on natural levee and abandoned point bar deposits, but soil textures become finer with increasing distance from major water courses. Accumulations of organic matter also occur at or near the soil surface in areas subject to prolonged periods of surface inundation and the chemical reduction and translocation of iron in many surface and subsoils results in the development of depleted and/or gleyed matrixes in soils exposed to high water tables, flooding or ponding.

Common soil series within the forested wetlands within the Yazoo Study Area include Sharkey clay (Very-fine, smectitic, thermic Chromic Epiaquerts), Alligator clay (Very-fine, smectitic, thermic Chromic Dystraquerts), Dowling clay (Very-fine, smectitic, nonacid, thermic Vertic Endoaquepts), Forestdale silty clay loam (Fine, smectitic, thermic Typic Endoaqualfs) and related series (Soil Survey Staff 2017). Field indicators of hydric soils have been documented within the Yazoo Study Area, including the commonly observed indicators Depleted Matrix, Depleted Below Dark Surface, Redox Depressions, and Stratified Layers (USDA-NRCS 2018).

Hydric soils provide a valuable tool to identify appropriate areas to implement wetland mitigation projects, because hydric soils have been shown to persist following alteration of hydrophytic vegetation communities and wetland hydrology. As a result, the abundance of hydric soils in the Yazoo Study Areas provides extensive opportunities to implement wetland mitigation and restoration projects and data available from previous research in the region helps to document the success of completed mitigation projects established on hydric soils in the region (Berkowitz 2019).

The USACE wetland delineation manual defines wetland hydrology as areas that are inundated or saturated to the surface continuously for at least 5.0% of the growing season in most years (50% probability of recurrence) (Environmental Laboratory 1987). Wetland hydrology has been further operationally defined using the technical standard described in USACE (2005) as occurring in those areas that are "inundated (flooded or ponded) or the water table is ≤12 inches below the soil surface for ≥14 consecutive days during the growing season at a minimum frequency of 5 years in 10 (≥50% probability)". This wetland hydrology threshold aligns with the recommendations of the National Research Council (1995), who stated that “data now available indicate that reasonable hydrologic thresholds would include a depth to water table of <1 foot (30 centimeter) for a continuous period of at least 14 days during the growing season, with a mean interannual frequency of 1 out of 2 years.” The 14 day threshold for wetland hydrology is also consistent with the approaches to identifying hydric soils and documenting the onset of anaerobic conditions for the purpose of developing field indicators of hydric soils (NTCHS 2015). The 14 day threshold is also indirectly considered a sufficient duration to influence the distribution of vegetation species based upon differences in their capacity to tolerate growth in saturated soils subject to anaerobic conditions. Within the Yazoo Study Area, the 14 day duration of wetland hydrology corresponds to 5.0% of the growing season and the 2-year floodplain corresponds with the ≥50% probability of flood waters inducing wetland hydrology events required by the wetland hydrology threshold. As a result, the USACE Vicksburg District has determined that those wetlands occurring within the 2-year floodplain that display flood duration during ≥5.0% (i.e., ≥14 days) of the growing season will be the focus of the wetlands assessment conducted in the Yazoo Study Area. Additional details related to the hydrology of the Yazoo Study Area, and the rationale used to determine the areas evaluated during the wetland assessment are provided in the Engineering Report Appendix.

At the field scale, wetland hydrology in the Yazoo Study Area has been documented through the observation of wetland hydrology field indicators, analysis of stream gauge data, and evaluation of water table monitoring data (Berkowitz et al. 2019). Field indicators of wetland hydrology commonly observed in the Yazoo Study Area include: Surface Water, High Water Table, Saturation, Sediment Deposits, Drift Deposits, Water Marks, Algal Mat or Crust, Water Stained Leaves, Oxidized Rhizospheres Along Living Roots, Surface Soil Cracks, Sparsely Vegetated Concave Surface, Drainage Patterns, Moss Trim Lines, Geomorphic Position, the FAC Neutral

Test, and Crawfish Burrows (USACE 2010).

2.2 Wetland hydrology and hydropatterns within the Yazoo Study Area

Wetland hydrology within the Yazoo Study Areas is of particular interest in the current analysis as the Proposed Plan has the capacity to alter the extent and timing of flood inundation in the Yazoo Study Area. Historically, prolonged and extensive inundation occurred in the Yazoo Basin following precipitation during the winter wet season (Smith and Klimas 2002). Localized flooding occurred as precipitation and runoff from the surrounding landscape (mostly the hills on the eastern edge of the basin) discharged into the tributary network of the Yazoo River, which provides the only natural drainage feature to the Mississippi River at the southern end of the basin. Additionally, large flood events associated with the Mississippi River and tributary system inundated most of the Yazoo Basin in some years (Moore 1972).

The modern levee system limits overbank flooding from the Mississippi River, but does not eliminate the influence of the river on wetland hydrology within the basin. For example, the major flood of 1973 affected approximately 40 percent of the Yazoo Basin; subsequent analysis indicated that in the absence of the levee system nearly the entire basin would have become inundated (USACE 1973). While the implementation of flood control measures has decreased flood frequency and duration in portions of the Yazoo Basin (Smith and Klimas 2002), development of the Mississippi River levee system in conjunction with incomplete flood control projects in the southern portion of the Yazoo Basin has increased wetland hydrology duration in some wetlands during some years (Stanturf et al. 2001). As a result of these landscape scale manipulations, the wetland hydropatterns observed in the Yazoo Study Area do not reflect historic conditions or natural patterns of wetland hydrology observed in other systems subject to overbank and backwater flood events.

Many forested wetlands associated with the Mississippi River and its tributaries, including those within the Yazoo Study Area, experience a combination of local precipitation and backwater flooding as major hydrologic influences (Smith and Klimas 2002). Backwater flooding describes inundation resulting from impeded drainage, usually due to high flood stages in downstream waterways that inhibits drainage within adjacent tributaries. Impeded drainage leads to increasing water tables and surface inundation on the landscape.

In the Yazoo Study Area, additional flooding results from water being held behind levees and water control structures associated with flood control projects. The development of water control structures, levees, and other features in the Yazoo Study Area have had significant effects on forested wetland hydropatterns. Available data suggests that the area experiences less large scale overbank flooding than was present under historic conditions (Smith and Klimas 2002) and an increase in the duration of backwater flooding in some portions of the Yazoo Study Area during some years (Stanturf et al. 2001). For example, over 550,000 acres of land was flooded for over six months in the Yazoo Study Area during 2019. The flooding was induced by extremely high local precipitation (over 200% above average) coupled with high river levels in the Mississippi River that persisted for >150 days which precluded downstream drainage and necessitated closure of multiple water control structures (NOAA 2020).

Although the impact of the unnatural flood durations associated with landscape scale alterations in the Yazoo Study Area has not been fully quantified, the effects of prolonged flooding on wetland ecosystems and ecological functions has been investigated in the Mississippi River watershed more broadly. For example, Sparks et al. (1998) reported increased tree mortality in forested wetlands following long duration flood events. These altered flood regimes also have important implications for faunal populations, vegetation communities and soil characteristics

(Moore et al 2011, Jones et al. 2019). For example, De Jager et al. (2012) reported a decrease in plant diversity and changes in soil textures as a result of longer flood durations and Schramm et al. (2009) suggested that nutrient cycling in the Mississippi River watershed has been altered under present day hydroperiods compared with historic conditions.

Most recently, a study by Price and Berkowitz (2020) documented decreases in a subset of wetland functions (i.e., ability to detain floodwater, detain precipitation, cycle nutrients, and export organic carbon) in the lower Mississippi River valley following extended flood inundation using an HGM model, reporting that some wetland functions declined as much as 23%. The study suggested that the decrease in wetland functional capacities following prolonged flood inundation will likely persist for a number of years following the recession of flood waters.

While additional studies are needed to elucidate the implications of long duration floods in the Yazoo Study Area, available data suggests that the extended flood durations observed in the region likely have negative effects on forest health and the habitat of a subset of species that utilize wetlands during a portion of their life cycle. Other sections of this SEIS discuss the impact of long duration backwater flood events on water quality, waterfowl, fisheries, and other resources.

Recent research also highlights an increase in the relative importance of precipitation for sustaining wetlands in the Yazoo Basin, associated with the decline in historic flood inundation patterns. Berkowitz et al (2019) evaluated hydrologic sources at 56 study locations, reporting that precipitation provided the sole source of wetland hydrology at 67.9% of wetlands. These locations exhibited no influence of flood inputs during the study (i.e., no wetland hydrology events linked with flooding occurred). Additionally, 19.6% of locations received sufficient precipitation to induce wetland hydrology, with subsequent flooding either 1) supplementing precipitation driven hydrology (10.7%) during a continuous event or 2) leading to a separate wetland hydrologic event (8.9%). These data collectively suggest that 87.5% of monitoring locations would continue to exhibit wetland hydrology in the absence of all flood inputs. Conversely, flooding provided the dominant source of wetland hydrology at only 12.5% of the monitoring locations, supplemented precipitation induced hydrology at 10.7% of the locations, and led to a separate wetland hydrology event at 8.9% locations.

To illustrate these findings, Figure 1 presents the distribution of wetland hydrology drivers based on data collected within the Yazoo Basin as presented in Berkowitz et al (2019). The study concluded that the majority of wetlands in the area are supported by local patterns of precipitation, and the influence of flooding on wetland hydrology had been previously overestimated. Within the context of the current SEIS these findings suggest that any decline in flood duration is unlikely to convert wetlands to uplands, despite any anticipated decrease in flood inundation duration.

These observations correspond with both the theoretical hydropatterns for several forested wetland types and the water balance in the Yazoo Study Area (Figure 2). Note that the water table increases in response to winter precipitation, with supplemental spring flood effects occurring in some areas. Water tables decrease during summer and fall in response to lower precipitation and increased evapotranspiration. The water balance (lower panel) corresponds to the theoretical water table fluctuations in the upper panels, with water surpluses occurring during the winter months, coinciding with the water table increases. The subsequent declines in precipitation and accelerating evapotranspiration during summer lead to soil moisture loss and moisture deficits, resulting in lower water tables. Cooler temperatures and increasing precipitation then recharge the system, with soil moisture gains occurring later in the year.

These graphics suggest that long term flood events persisting far into the growing season do not conform to the natural patterns of wetland hydrology in the Yazoo Study Area.

The timing of wetland hydrology derived from precipitation events also differs from flood events (Figure 3; Berkowitz et al. 2019). In particular, the occurrence of long duration flood events persisting well into the growing season has been shown to negatively impact tree survival and forest health. For example, Cosgriff et al. (1999) reported tree mortality rates > 40% and associated shifts in community composition and structure following 195 days of floodplain inundation associated with the 1993 flood on the upper Mississippi River. The recent backwater flood events in the Yazoo Study Area also persisted well into the growing season, and early observations suggest that tree mortality may be occurring as result of extreme flood duration. Comprehensive studies of tree mortality will be required to quantify the negative impacts of those events on forest structure, including the capacity of the region to support threatened and endangered species that are sensitive to changes in hydroperiods and hydropattern (e.g., *Lindera melissifolia*).

Finally, the hydroperiods associated with precipitation driven wetlands far exceed the flood duration observed within the study area regardless of flood duration interval (Figure 4). For example, areas within the <7 day flood duration interval exhibited an average of 88 days of soil saturation over an eight year period; study locations within the 7-14 day flood duration interval exhibited an average of 151 days of saturation; and areas with mapped flood durations >14 days exhibited an average soil saturation period of 172 days (Table 1). Note that regardless of flood duration or frequency interval, all areas exhibited extended periods of soil saturation that greatly exceeded the 5% of the growing season (14 day) threshold required for wetland hydrology. These data demonstrate that any decline in flood duration is unlikely to convert wetlands to non-wetlands, despite any anticipated decrease in flood inundation duration and associated implications for wetland functions.

2.3 Wetland functions and functional assessment in the Yazoo Study Area

Wetlands provide a variety of functions (e.g., water storage, floral and faunal habitat) and values (e.g., flood risk reduction, recreation) within the Yazoo Basin (Smith and Klimas 2002). However, historic landscape alteration has resulted in significant declines in forested wetland acreage with the Yazoo Study Area and the broader lower Mississippi River alluvial valley that have induced losses of wetland functional capacities in the region (King et al. 2006). Wetland disturbances resulted from a combination of factors including conversion of forested wetlands to agriculture, implementation of drainage networks, and alteration of hydrology at large spatial scales within the Yazoo Study Area through the development of levees and other flood control features (Smith and Klimas 2002).

Recent efforts to assess and restore wetlands have been implemented, resulting in the development of novel technical approaches to quantitatively evaluate wetland functional capacity. The current report applies those methodologies to assess potential unavoidable impacts to wetland resources associated with the Proposed Plan. In particular, the HGM approach has been applied to assess wetland functions in the Yazoo Basin in addition to other areas, and published research has recognized HGM as the best available methodology to conduct wetland assessments across broad spatial scales (Cole 2006). The methodology was also developed to determine project impacts and determine mitigation requirements in the context of the Clean Water Act (Smith et al. 2013).

Smith and Klimas (2002) developed a regional HGM guidebook specifically for the Yazoo Basin, providing a data-driven and regionalized methodology to assess wetland functions within the Yazoo Study Area. Berkowitz and White (2013) validated a subset of the relationships developed by Smith and Klimas, demonstrating the utility of the HGM tool using direct measures of wetland function and supporting the application of the HGM approach within the Yazoo Study Area for quantifying wetland functions and determining mitigation requirements. Additionally Berkowitz (2019) evaluated wetland functions across a restoration chronosequence using the HGM method, providing additional support for the method by documenting the ability of the approach to detect changes in wetland functions as forest succession occurs (Figure 5). That study highlighted the capacity of wetland mitigation projects in the Yazoo Study Area to offset wetland impacts from previously constructed projects by depicting the increase in wetland functions with increasing mitigation stand age.

2.4 Previously completed mitigation in the Yazoo Basin

The following evaluates data gathered during execution of a monitoring program at existing mitigation sites in the Yazoo Basin in order to provide context for the determination of compensatory mitigation requirements in the current analysis. The monitoring program encompasses a >11,800 hectare area and includes 606 HGM study plots, representing one of the largest wetland restoration datasets in the lower Mississippi River valley (Berkowitz 2019). The availability of data from the Yazoo Basin, collected at repeated intervals across a chronosequence spanning >20 years provides a unique resource for evaluating wetland conditions and mitigation success. Available data provides evidence that mitigation in the Yazoo Study Area can effectively offset impacts to wetland resources. The data derived from

Berkowitz (2019) is also utilized to determine the performance of mitigation wetlands and calculate the mitigation requirements outlined in subsequent sections of this appendix.

The USACE wetland restoration initiative began in 1990, representing some of the oldest large-scale reforested wetland tracts in the region, with periodic additional land acquisition occurring over time (Table 2). The periodicity of afforestation provides a mechanism for examining restoration success across a chronosequence exhibiting wetland functions under various conditions as forest succession occurs. This restoration chronosequence enables analyses of mitigation success and informs expected conditions at future mitigation sites in the region.

Researchers have documented substantial increases in tree diameter, initiation of canopy closure, and other factors related to forest succession across the oldest restoration sites (>25 years) compared to site evaluations conducted in previous monitoring events (Berkowitz 2019). Evaluating the restoration chronosequence, significant increases in tree basal area occurred (Figure 6). The HGM assessment technique evaluates trees with a diameter at breast height (DBH) ≥10 centimeters. This diameter was first encountered at a subset of 10 year stands, with significant increases documented in 13-20 year old stands, and further improvements at the 20-25 year post restoration increment following a linear increase in diameter over the restoration chronosequence.

Tree density data displayed similar results, with significant incremental increases in tree density occurring within the restoration sites after 13 years, followed by further significant increases at 20 and 25 year time intervals. Because the HGM approach focuses on trees with DBH ≥10 centimeter and includes smaller tress in shrub-sapling density measurements, observed increases in tree density likely represent a combination of 1) incorporation of planted trees entering the 10 centimeter size class and 2) recruitment of naturally regenerated trees into restored areas over time.

Woody debris biomass inputs were expected to increase in response to higher basal area and tree density values, which provide additional sources of woody debris (e.g., loss of branches during storms and self-pruning). Monitoring results indicate significant linear increases in woody debris across the restoration chronosequence. Further additions of woody debris biomass are anticipated as stand development continues into the stem exclusion phase of forest succession. Ground vegetation cover follows anticipated patterns after restoration. First, coverage increases with the cessation of agricultural activities (e.g., plowing, crop removal); then ground vegetation cover decreases as transient species are recruited to taller strata and canopy cover approaches closure, reducing the quantity and quality of available light supporting herbaceous plant growth. Shrub-sapling density data displayed similar patterns, with initial increases followed by sharp declines as restoration site succession progressed. Soil horizon development increased over the restoration chronosequence, with significant differences in O-horizon thickness detected 25 years post restoration. Examining the entire dataset, the wetland assessment variables evaluated generally displayed expected responses to restoration, with assessment metrics following anticipated patterns across the restoration chronosequence.

The following examines changes in wetland functions across the restoration chronosequence and provides a discussion of the drivers behind functional increases. The detain floodwater function displayed significant increases across the restoration chronosequence, most notably within the 20 and 25 year age classes (Figure 7). The increases in functional scores result from improvements in ground vegetation, shrub-sapling density, and tree density assessment variable scores. The functional outcomes are anticipated to increase further as these variables, which provide physical obstructions within the wetland that decrease overland flow velocity, continue to develop over time. Additional improvements in the detain floodwater function are expected to result from the incorporation of the log biomass variable as forest succession progresses, as the absence of downed logs at restoration sites decreases floodwater functional scores by up to 25% within the current 25 year dataset.

The detention of precipitation function represents a largely physical process chiefly occurring via micro-depressional storage, infiltration and retention by organic material and soils (Smith and Klimas 2002). As a result, the detain precipitation function has the potential to yield functional benefits immediately after restoration occurs, without the necessity for tree maturation to occur as required for several other functions including fish and wildlife habitat maintenance. The detain precipitation function showed significant increases after 10 years across the restoration chronosequence, followed by small improvements throughout the remainder of the 25 year chronosequence. Further improvements in the detain precipitation functions are anticipated as additional organic matter accumulates in surface soil horizons and increases in surface roughness (i.e., microtopography) occur via tree throw, bioturbation, and other mechanisms.

Notably, a subset (13%) of the 606 restoration sample sites examined exhibited functional scores >0.80 functional capacity index, yielding results comparable to conditions observed at mature wetland forests (average of 0.81 ±0.02 functional capacity index). These high-scoring detain precipitation function sites encompassed the entire range of the restoration chronosequence (i.e., 5-25 years) demonstrating the capacity of mitigation projects to display substantial benefits to physically dominated wetland functions over short time periods.

Previous studies examined the nutrient cycling function across the restoration chronosequence, comparing the HGM assessment results with direct measures of wetland nutrient cycling. Those studies linked measures of soil carbon and nitrogen with nutrient processing mechanisms including soil microbial biomass and potentially mineralizable nitrogen (Berkowitz and White 2013). Results indicated that higher rates of nutrient cycling function (i.e., higher nutrient content and processing capacity) corresponded with increased HGM assessment outcomes, validating the wetland functional assessment approach.

Examining the chronosequence data, the nutrient cycling function displayed significant increases during both the 20 and 25 year restoration intervals. Seven assessment variables related to carbon accumulation and processing (e.g., tree basal area, O-horizon thickness) drive the nutrient cycling functional score. As a result, continued tree growth, soil horizon development, and the generation of additional woody debris will likely result in higher nutrient cycling functional outcomes in the future. The incorporation of snags (currently absent from restored forests; decreasing functional scores by up to 12.5%) as forest succession continues will further increase nutrient cycling functions toward conditions observed in mature forested wetlands. The available dataset suggests that a subset (5%) of restored sites are providing nutrient cycling functions at equivalent levels observed in mature wetland forests. Those locations occur in the older restoration age classes (20-25 years post restoration).

The export organic carbon function combines flood frequency and duration data with assessment variables that serve as proxy measures of carbon sources (e.g., woody debris biomass) available for export to downstream environments. The export organic carbon function were similarly validated by linking soil organic carbon concentrations with direct measurements of inundation frequency and duration, thus providing a mechanism for organic carbon export to occur. Export organic carbon scores remain significantly higher in 25 year old restoration sites. With increasing site maturity, additional accumulation of above and below ground carbon stocks is anticipated, resulting in higher export organic carbon functional scores over time.

The remove elements and compounds functions also utilizes the flood frequency and duration for determining functional assessment capacities. The remaining variables associated with the function (i.e., soil cation exchange capacity, O- and A-horizon thickness) provide proxy measures of a restored wetlands ability to improve water quality through the sequestration of nutrients, heavy metals, pesticides and other imported materials from floodwaters. As a result, restored locations with frequent flood return intervals and favorable soil conditions display increased capacity for providing the remove elements and compounds function. This accounts for the high scores observed within the 5 and 10 year restoration intervals and the overall higher functional outcomes compared to most of the other functions examined herein. Notably, a subset of the older restoration site intervals display statistically significant increases in remove elements and compounds functional scores due to improvements in the soil horizon variables. This demonstrates the impact of site maturation and accumulation O- and A- soil horizon biomass over time.

The maintain plant communities function exhibited statistically significant increases across the restoration chronosequence, with 30% (>200) of the 606 study sites exhibiting functional capacity index values ≥0.80. Steady increases in functional assessment scores resulted from improvements in tree basal area and density with additional functional score increases expected as additional tree growth occurs. The high initial level of wetland plant community function can be attributed to the species composition variable, which are intentionally maximized at restoration sites through selective planting of highly desirable species outlined in Smith and

Klimas (2002). As a result, plant community functions exceeded the values observed in mature wetland forests in the region (0.71±0.02) at >50% of the 606 study sites examined. These factors result in the highest scores for the functions examined in the wetland assessment and emphasize the benefits of utilizing appropriate plant communities during restoration design and implementation.

The provide fish and wildlife habitat (i.e., habitat) functional scores display initial functional capacity index values of zero for the first five years post restoration due to the absence of trees, snags, and logs. Scores steadily increase with the onset of tree development, with significant functional increases occurring after 10, 13, and 25 years after restoration. The incorporation of snags and log biomass along with additional tree growth will drive further functional increases as forest succession proceeds.

As noted elsewhere, additional increases in wetland functional scores are anticipated in the future. In some cases, specific wetland functional increase thresholds can be identified and related to changes in mitigation site conditions. For example, the lack of snags in early- and middle-aged mitigation sites decreases wetland functional capacity scores by 12.5%. Many of the variables associated with the HGM approach will show continued improvements as forest succession proceeds. For example, variables related to forest structure (e.g., tree diameter, tree density, sapling-shrub density) will continue to develop. Improvements in carbon accumulation will increase the level of wetland functions through recruitment of woody debris, soil organic matter, and ground vegetation cover. The incorporation of snags and logs (which are both currently absent from existing mitigation sites) will further drive functional score increases.

In summary, previous studies demonstrate that existing mitigation locations 1) display improved wetland assessment variable scores over time, 2) display increases in wetland functional scores over time, and 3) are anticipated to display additional functional increases in the future. As forest succession proceeds, wetland mitigation sites will continue to approach the level of wetland functions observed in mature forested wetlands. These results demonstrate that future mitigation efforts can successfully offset impacts associated with the development of additional civil works projects in the Yazoo Study Area. More importantly, the available data can be used to estimate the performance of mitigation lands within the region.

3 Approach

The following subsections describe the methodology used to conduct the wetlands assessment. First, a description of the approach utilized to determine the land cover classifications and the extent of wetlands within the project area is provided (3.1). Second, the method used to apply the HGM approach and conduct the wetlands assessment is presented (3.2). Third, the determination of mitigation requirements is described (3.3). Additionally, although not included in the wetland assessment, a discussion of the non-structural project components of the Proposed Plan is included (3.4). All evaluations were conducted to encapsulate a 50 year period of analysis.

3.1 Land cover classification and wetland extent

The Yazoo Study Area was defined by the USACE Vicksburg District staff and is described elsewhere in this document. Land cover classification was determined using 2018 NASS Cropscape data layers provided by the USACE Vicksburg District. The land cover data included the following designations: Background, Corn, Cotton, Rice, Soybeans, Winter Wheat, Double

Crop Winter Wheat/Soybeans, Other Hay/Non Alfalfa, Sod/Grass Seed, Fallow/Idle Cropland, Pecans, Aquaculture, Open Water, Developed/Open Space, Developed/Low Intensity, Developed/Med Intensity, Developed/High Intensity, Barren, Deciduous Forest, Evergreen Forest, Mixed Forest, Shrubland, Grassland/Pasture, Woody Wetlands, and Herbaceous Wetlands. Land cover classes were aggregated into the following cover classifications to facilitate the assessment: 1) mature forested wetlands, 2) agricultural croplands, and 3) non-wetland areas. This approach differs from the analysis presented in the 2007 FSEIS, which differentiated between Mature Forest, Middle Aged Forest, Early Aged Forest, Recently Logged, Agricultural, and Other areas.

1) The mature forested wetland cover type included all forested areas regardless of type or successional stage and all unmanaged lands that would have the potential to develop into mature forests during the period of analysis. This includes the following land classifications: Background, Pecans, Barren, Deciduous Forest, Evergreen Forest, Mixed Forest, Shrubland, Woody Wetlands, and Herbaceous Wetlands. The assumption that all of these areas were assumed to be mature forests accounts for the potential for early successional stage forests to mature during the period of analysis, providing the highest possible forested wetland functional scores across the Yazoo Study Area. Further, because mature forested wetlands receive the highest scores with the HGM assessment approach this also represents the most conservative possible approach for evaluating potential impacts to forested wetland resources. For example, the average Functional Capacity Index (FCI) score in mature forests is 0.83, while the average FCI in early aged forests is only 0.47. As a result, the assumption that all non-agricultural wetlands in the Yazoo Study Area are mature forests yields a substantial increase in wetland

functional capacity scores compared with approaches that consider other forest successional stages.

2) The agricultural cropland cover type incorporated all areas under row crop production and recently fallowed fields including the following cover classes: Corn, Cotton, Rice, Soybeans, Winter Wheat, Double Crop Winter Wheat/Soybeans, Other Hay/Non Alfalfa, Sod/Grass Seed, Fallow/Idle Cropland, and Grassland/Pasture. The wetlands assessment assumes that all lands currently under active agricultural production will remain managed and be maintained in an un-forested condition throughout the period of analysis.

3) The non-wetland land cover class included all areas designated as open water or aquaculture as well as the various categories of developed lands. The non-wetland land cover categories include the following classifications: Aquaculture, Open Water, Developed/Open Space, Developed/Low Intensity, Developed/Med Intensity, Developed/High Intensity.

Notably, the identification and delineation of wetlands within the project area was a major focus of the 2007 FSEIS, and extensive work was conducted by multiple federal agencies in order to estimate the distribution of wetlands within the project area. For the purposes of the current assessment, the extent of jurisdictional wetlands within the direct impact area (i.e., the physical footprint of the pump station, borrow areas, and other infrastructure) were determined by the USACE Vicksburg District Regulatory Branch. The procedures applied included both a wetland delineation and preliminary jurisdictional determination. The results of that determination include the acreage of jurisdictional forested and agricultural wetlands that were subsequently included in the assessment of wetland resources within the direct impact area.

The extent of wetlands within the indirect impact area (i.e., areas subject to potential shifts in flood duration under the Proposed Plan) within the Yazoo Study Area were considered wetlands if they met the following criteria: 1) occurred within the 2-year floodplain, 2) exhibited a flood duration interval of ≥5.0% of the growing season (i.e., ≥14 days), and 3) were classified as either forested wetlands or agricultural cropland cover types described above. Information on the extent of areas within the 2-year floodplain and the ≥5.0% flood duration intervals were provided by the USACE Vicksburg District Engineering and Construction Division. The approach considers all non-wetland areas within the Yazoo Study Area to have wetland assessment score of zero, because they fail to meet the wetland criteria used for wetland identification and do not provide wetland functions.

This represents a conservative approach to determine indirect impacts because many forested, agriculture, pasture, and other areas within the Yazoo Study Area would not meet the hydrophytic vegetation, hydric soils, and/or wetland hydrology criteria outlined in Environmental Laboratory (1987) and the delineation procedures detailed in USACE (2010). Additionally, this approach incorporates any forested and agricultural lands within the 2-year floodplain and ≥5.0% flood duration intervals that are non-wetlands, may be considered isolated wetlands, meet the definition of prior converted croplands, or may otherwise be excluded from consideration during a traditional wetland delineation and functional assessment. The presence of non-wetlands within the Yazoo Study Area was reported in the 2007 FSEIS when a number of areas occurring within the ≥5.0% flood duration intervals were determined to be non-wetlands using traditional wetland delineation techniques (e.g., field indicators of hydric soils, hydrophytic vegetation, and wetland hydrology). For example, EPA data collected in the Yazoo Study Area within areas exhibiting ≥5.0% flood duration zones reported that five of the 52 data points (9.6%) examined were determined to be non-wetlands.

3.2 The application of the HGM method

The following focuses on the application of the HGM assessment and the methods utilized to determine the potential impacts to wetland resources. The HGM method selected for the wetlands assessment applies the methodology described by Smith and Klimas (2002) in the Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Selected Regional Wetland Subclasses, Yazoo Basin, Lower Mississippi River Alluvial Valley. Additionally the wetland assessment includes the modifications outlined by Smith and Lin (2007) in Yazoo Backwater Project: Assessing Impacts to Wetland Functions and Recovery of Wetland Functions in Restoration Areas. The modifications were developed to incorporate flood duration data into the assessment approach, which was not available at the time Smith and Klimas (2002) was published. Both methods have been certified for use by the USACE National Ecosystem Restoration Planning Center of Expertise.

This methodology was selected because it 1) was developed within the Yazoo Basin and incorporated data collected within the Yazoo Study Area, 2) provides for analysis of both the No Action Alternative and the Proposed Plan using quantitative measures of wetland functions, 3) allows for analysis over the 50 year period of analysis, and 4) supports the determination of compensatory mitigation requirements. Additionally, the approach was developed following the Guidelines for Developing Guidebooks (Smith et al. 2013) which incorporates elements to ensure technical quality of the method including: input from an interagency assessment team; scaling of assessment models based upon data collected at reference standard locations; development and testing of a written protocol; wetland classification and development of wetland subclasses specific to the region of application; calibration, verification, and field testing of the assessment; and external peer review.

The HGM model developed for application in the Yazoo Study Area addresses a number of wetland subclasses. For the purpose of the current assessment, all wetlands are assumed to be within the Riverine Backwater subclass. This selection was made because 1) the wetlands examined occur within the 2-year flood frequency interval and 2) the Riverine Backwater subclass encompasses the full suite of wetland functions described in Smith and Klimas (2002).

The HGM models incorporate 19 variables (Table 3) collected using a combination of on-site and off-site approaches (Figure 8). Data for each HGM variable was collected at 43 mature study locations within the Yazoo Study Area during the summer of 2016. Variable metric data was transformed into variable subindex scores ranging from 0.0 to 1.0, and wetland functional capacity index (FCI) scores were calculated using empirical equations (Table 4). When determining the HGM metric input for the flood duration variable (V_{DUR}) the centroid of the flood duration interval was applied. For example, for those areas within the 5-7.5% flood duration interval, a metric value of 6.25% was used to determine the V_{DUR} subindex score. The FCI scores are then converted to Functional Capacity Units (FCUs) by accounting for the spatial extent of each land cover types described above within the Yazoo Study Area (Smith et al. 2013).

The resultant FCI scores were compared with those derived from 39 mature forest locations sampled during the development of the 2007 FSEIS. It was determined that despite being very similar overall, the values collected during 2020 in support of the current assessment yielded slightly lower FCI scores than reported in the 2007 FSEIS (average FCI difference <0.09). As a result, the FCI scores reported in the 2007 FSEIS were selected to conduct the current analysis. This approach represents the most conservative approach possible, since it applied the higher set of scores available between the two datasets.

Average Annual Functional Capacity Units (AAFCUs) are then evaluated over a 50 year period of analysis under the No Action Alternative and the Proposed Plan to determine mitigation requirements using Equations [1] and [2]. The sum of all functional scores approach was selected to determine impacts and mitigation requirements based on recommendations of Smith et al. (2013).

The conditions in mature forested wetlands and agricultural croplands in the Yazoo Study Area can be considered stable for purposes of the wetlands assessment, as evidenced by the lack of significant differences between the results presented in the 2007 FSEIS and those observed during the collection of field data in 2020. For example, mature forested wetlands already receive the highest possible variable subindex score (1.0) for the variables most likely to change over time including tree basal area, tree density, snag density, and other variables. As a result, the FCI scores for the No Action Alternative are not adjusted over the 50 year period of analysis.

$$Cumulative\ FCUs =$$

$$\Sigma(Target\ Year_2 - Target\ Year_2)\ \{\frac{[Area_1 FCI_1 + Area_2 FCI_2]}{3} + \frac{[Area_2 FCI_1 + Area_1 FCI_2]}{6}\} \qquad [1]$$

$$AAFCUs = \frac{(Cumulative\ FCUs\ between\ all\ Target\ Years)}{50\ years} \qquad [2]$$

The analysis of direct project impacts first determined the AAFCUs associated with the jurisdictional forested and agricultural wetlands within the physical project footprint (i.e., pump station, borrow areas) under the No Action Alternative. For the purpose of the assessment, the direct impact area was assumed to occur in the >12.5% flood duration interval, which yields the highest possible HGM results within the dataset. The AAFCUs are then generated for the

Proposed Plan, under which all wetland functions within the direct impact area are reduced to zero. The difference between the AAFCUs under the two alternatives represents the direct impacts of the project.

The analysis of indirect impacts first determines the AAFCUs associated with the forested and agricultural wetlands as defined above within the remainder of the Yazoo Study Area under the No Action Alternative. This includes the incorporation of flood duration data provided by the USACE Vicksburg District Engineering and Construction Division. The estimated duration of flooding was derived using the Flood Event Simulation Model (FESM), which reports the following flood duration intervals: 0.0% of the growing season (no flooding), <2.5% of the growing season (corresponding to <7 days), 2.5-5% (7-13 days), 5-7.5% (14-20 days), 7.5-10% (21-27 days), 10-12.5% (28-34 days), and >12.5% (>35 days). All HGM calculations utilized the mid-point of each flood duration range, for example an estimated flood duration of 6.25% of the growing season was applied to all land cover classes within the 5-7.5% flood duration interval.

The estimated duration of flooding associated with each land cover type was determined under both the No Action and Proposed Plan. This allowed for analysis of changes in HGM FCI values and supported the calculation indirect impacts to wetland functions.

The AAFCUs are then generated for the Proposed Plan, under which a subset of the wetlands will undergo a downward shift in the duration of flood water inundation and an associated decrease in wetland function. The difference between the AAFCUs under the No Action and Proposed Plan represents the indirect impacts of the project.

3.3 Determining mitigation requirements

Mitigation requirements were determined for the Yazoo Study Area based upon both direct (pump station and other infrastructure) and indirect impacts (anticipated changes in flood duration). In order to compensate for potential decreases in wetland functional capacity, a mitigation plan will be instituted. Mitigation within the region consists of re-establishing forested wetlands on agricultural lands with hydric soils. These efforts have proven successful for offsetting unavoidable impact to wetland resources, and published research tracks the trajectory of habitat, hydrology, and biogeochemical functional improvements within the established USACE mitigation lands (Berkowitz 2019). The current report assumes that similar mitigation approaches will be applied for the projects described herein. Additional information on the mitigation plan are provided in the Mitigation and Monitoring and Adaptive Management Plan sections of this document.

Mitigation projects reclaim forested wetlands previously converted to agriculture, many of which exhibited marginal production due to seasonal high water tables and/or the need for extensive drainage. Mitigation activities include planting desirable forested wetland tree species, selected for their capacity to thrive on hydric soils and subject to wetland hydrology. Characteristic species utilized for mitigation include *Quercus phellos* (Willow Oak), *Quercus texana* (Nuttall Oak), *Quercus lyrata* (Overcup Oak), *Carya aquatica* (Water Hickory), and other flood-tolerant hydrophytes associated with high wetland habitat values (Smith and Klimas 2002). Afforestation typically occurs via row planting at typical seedling spacing of three to four meters.

Data from existing USACE mitigation lands, information within the HGM guidebook, and previously published literature were used to determine FCI values at target years 0, 5, 10, 20, 35, and 50 (Tables 5-21). Specifically, for each HGM variable the available data from existing mitigation sites was applied for target years 0-20 based on the information presented in Berkowitz (2019). Estimated HGM variable input data presented in Smith and Klimas (2002) were used to generate the inputs for target years 35 and 50. The resultant subindex scores were used to calculate the FCI values at each target year (Table 22). The AAFCUs generated by 1.0 acre of mitigation lands across the period of analysis were interpolated between target years using equations [1] and [2] (Table 23). The AAFCUs for each function are summed to yield the total AAFCUs provided by 1.0 acre of mitigation land during the 50 year period of analysis. The target year analysis indicates that 1.0 acres of mitigation is required to offset a 4.78 decrease in AAFCUs (Table 23). As a result, a project impact of -478 AAFCUs would require establishment of 100 acres of compensatory mitigation.

3.4 Nonstructural forested wetland establishment

Although not included in the determination of compensatory mitigation, the Proposed Plan includes the acquisition and reforestation of 2,700 acres of agricultural lands at or below elevation 87.0 NGVD as a nonstructural component of the project. The wetland functional benefits of the nonstructural lands will be determined using the same approach outlined above, although a subset of HGM variable inputs will differ from the values presented in Tables 5-21. The differences result from potential limitations and uncertainties associated with how nonstructural lands are selected. The nonstructural lands will be established by reforesting agricultural lands through perpetual easements from willing sellers. As a result, the nonstructural reforestation parcels likely differ from compensatory mitigation lands in several ways. For example, nonstructural reforestation areas may be smaller than the large parcels targeted for compensatory mitigation, may lack contiguous forested wetland boundaries, and exhibit other features that decrease their functional capacity. This decreases several of the HGM variable inputs (e.g., V_{TRACT}, $V_{CONNECT}$), subindex scores, and FCI values compared with the values for compensatory wetland mitigation areas described in the previous section. The estimated HGM inputs, variable subindex scores and AAFCUs for the nonstructural project components are provided in Tables 25-43. The AAFCUs for each function are summed to yield the total AAFCUs provided by 1.0 acre of nonstructural land during the 50 year period of analysis. The target year analysis indicates that 1.0 acres of non-structural land yields 3.95 AAFCUs (Table 44).

4 Results

4.1 No Action Alternative

The direct impact area encompasses 290 acres, including 46 acres associated with a borrow area and 244 acres occupying the pump station location and surrounding infrastructure. A total of 84 acres of jurisdictional wetlands were identified by the USACE Vicksburg District within the direct impact area; 61 acres associated with the pump station and surrounding infrastructure, including 59 acres of forested wetlands and two acres of agricultural wetlands. The proposed borrow area contained 23 acres of agricultural wetlands (Table 45, Figures 9-10).

The HGM variable metric inputs, variable subindex scores and FCI values for the wetlands in the direct impact area are displayed in Tables 46-47. Note the forested wetlands in the direct impact area exhibit high levels of wetland function capacity (average FCI value = 0.84) due to the assumption that they are composed of mature forests. The agricultural wetlands in the direct impact area display lower FCI values (average = 0.25) due to the absence of a tree strata, desirable vegetation species, ongoing agricultural activities, and conditions associated with the accumulation of organic biomass (e.g., woody debris, logs). The wetlands in the direct impact area collectively yield 444 FCUs. Because the conditions within mature forests (e.g., V_{TBA},

V_{TCOMP} already receive the maximum variables subindex scores) and active agricultural areas are not anticipated to undergo a change in land use over the period of analysis, wetlands in the direct impact area provide 444 AAFCUs (Table 48).

A total of 97,677 acres of land are located in the 2-year floodplain, ≥5.0% flood duration intervals occur within the indirect area of the Yazoo Study Area, including 82,981 acres of forested (74,211 acres) and agricultural lands (8,770 acres) being evaluated in the wetlands assessment. The distribution of areas are provided in Table 49 organized by the three land cover classifications described above and flood duration interval. Visual representations of the location of wetland areas are included in the assessment under the No Action Alternative are presented in Figures 11-14 (left panels).

The HGM variable inputs and variable subindex scores for each flood duration interval are depicted in Tables 50-63, including all flood duration intervals generated using FESM (0.0 to >12.5% of the growing season). The HGM wetland functional capacity scores for wetlands in the indirect impact area are summarized in Table 64, documenting the high level of functions provided by the mature forests (average FCI = 0.77) in the Yazoo Study Area and the low levels of functions provided by agricultural areas (average FCI = 0.22). Because the wetland functional capacities in the Yazoo Study Area are not anticipated to change over the period of analysis, the determination of the AAFCUs present under the No Action Alternative is determined by multiplying the FCI scores by the spatial extent of each land cover type and flood duration interval.

Existing conditions in the indirect impact area provide a total of 505,696 AAFCUs, including 488,982 AAFCUs and 16,714 AAFCUs from forested and agricultural areas respectively

(Tables 65-66). In total, existing conditions provide 506,141 AAFCUs across both direct and indirect impact areas as summarized in Table 67.

4.2 Proposed Plan

Implementation of the Proposed Plan will result in a decrease of wetland functions within the direct impact area as construction activities convert the wetlands presented under the No Action Alternative, which provide 444 AAFCUs, to non-wetland land cover types. The direct impacts will result in a loss of 444 AAFCUs (Table 68).

Within the indirect impact area the Proposed Plan is not expected to alter the flood duration of the majority (44,207 of 82,981 acres; 53%) of wetland areas in the Yazoo Study Area (Table 69). The remaining acreage (38,774 acres; 47%) will exhibit a shift in flood duration (Figure11-14). As noted elsewhere, the change in flood durations is not anticipated to result in the shift of wetland habitats to non-wetland habitats due to the role that precipitation plays in sustaining wetland hydrology in the Yazoo Study Area. However, the alteration of flood duration does have the capacity to decrease wetland functions.

The largest anticipated shifts in flood duration include the movement of 18,788 acres in the 5.0-7.5% flood duration interval under the No Action Alternative into the 2.5-5.0% flood duration interval under the Proposed Plan. Other substantial changes in flood duration would occur between the 7.5-10% interval and the 5.0-7.5% interval (4,626 acres) and between the 10-12.5% interval and the 7.5-10% interval (4,396 acres). In total, 56,038 acres (68%) of wetlands in the indirect impact area will continue to exhibit flooding during a minimum of 5.0% of the growing season. The remaining 26,942 acres (32%) are expected to remain wetlands, but shift into flood duration intervals below the 5.0% threshold. This suggests that flooding will contribute a smaller proportion of the wetland hydrology sustaining those areas under the Proposed Plan than under the No Action Alternative. However as noted elsewhere a combination of precipitation and flooding sustain the wetlands within Yazoo Study Area and decreases in the flood duration are not anticipated to convert wetlands to non-wetland habitats (Berkowitz et al. 2019).

In order to quantify the changes in wetland functions, the differences in FCI scores between flood duration intervals was determined and the change in AAFCUs was calculated as presented in Tables 70-79. Results indicate that a decrease of 11,054 AAFCUs will occur across the indirect impact area with implementation of the Proposed Plan (Table 80).

In total, the direct and indirect impacts of the Proposed Plan will result in a loss of 11,498 AAFCUs (Table 81). This represents a 2.2% decrease in the AAFCUs provided under the Proposed Plan when compared to the No Action Alternative. Overall, 97.8% of the AAFCUs within the Yazoo Study Area will be retained under the Proposed Plan and compensatory mitigation would be required to offset the decrease in wetland function.

4.3 Compensatory mitigation requirements

Compensatory mitigation would offset the estimated 2.2% impacts to wetland resources outlined above (i.e., net change of -11,498 AAFCUs; Table 81). Mitigation will be accomplished through reforestation of agricultural lands exhibiting hydric soils within the Yazoo Basin, as described in the Mitigation plan; additionally, a detailed Monitoring and Adaptive Management plan can be found in another section of this document to address any short falls in the recovery of AAFCUs during mitigation and identify opportunities to improve the wetland functions provided at mitigation sites.

In order to determine the mitigation requirements HGM assessment variable metrics, variable subindex scores and FCIs have been developed across the period of analysis as presented in

Tables 5-22. Additionally, the performance of mitigation areas has been estimated over the 50 year period of analysis, including the number of AAFCUs generated at each target year (Table 23). Those analyses demonstrate that 1.0 acre of mitigation land is required to offset an impact of -4.78 AAFCUs (Table 24). As a result, a total of 2,405 acres of mitigation is required to offset the wetland impacts associated with the implementation of the Proposed Plan (Table 82). This includes 93 acres of mitigation associated with direct project impacts and 2312 acres of mitigation to offset indirect impacts (Tables 83-84).

Table 85 provides a comparison of the results presented herein with the findings of the 2007 FSEIS. The most notable difference between the two wetland functional assessments is the change in wetland acres occurring below the ≥5.0% flood duration interval (189,600 vs 82,981 acres). The decrease in wetland acreage results from the availability of new data encompassing a more comprehensive hydrologic Period of Record (POR) and improved digital elevation models (DEM). Specifically, the 189,600 acres were identified utilizing the 1943-1997 POR and the 30-meter DEM available at the time the 2007 FSEIS was drafted. Subsequent improvements in elevation mapping led to the development of a DEM with a 10-meter resolution, resulting in an estimated 52,000 acre decrease in the extent of lands occurring below the ≥5.0% flood duration elevation. The decrease in acreages relates to the increased ability to detect ridges and other higher elevation features using the improved resolution data.

Additionally, the application of a new and more complete POR (1978-2019) further reduced the extent of areas below the ≥5.0% flood duration elevation by an estimated 57,000 acres. The decrease in wetland extent due to the new POR results from the completion of several flood control features. The Holly Bluff Cut-off was completed in 1958, and the Yazoo Backwater Levee was completed in 1978. These flood control features reduced stages in the study area.

The median ≥5.0% flood duration elevation threshold was lowered approximately one to three feet as a result of implementation of the flood risk reduction features, translating to a large aerial decrease in potential wetland areas when superimposed on the Yazoo Study Area.

4.4 Nonstructural component

The non-structural component is not included in the assessment of compensatory mitigation, but is included here for informational purposes. The establishment of 2,700 acres of non-structural reforestation of agricultural lands at or below elevation 87.0, NGVD would generate an estimated 10,667 AAFCUs over the period of analysis (Table 86). These increases in wetland functions would be equivalent to the functions provided by 2,232 acres of compensatory forested wetland mitigation lands in the Yazoo Study Area and result in a net increase of 2.1% in wetland function following implementation of the Proposed Plan.

5 Summary

This wetland assessment applies the latest information about wetland hydrology, ecological function, and forested wetland restoration available within the Yazoo Study Area. The approach outlined above is based on multiple peer-reviewed publications, resulting in the most data-driven assessment possible. Additionally the analysis makes a number of assumptions that ensure the assessment of wetland resources is conservative, including the following: 1) all forested and agricultural lands within the ≥5.0% flood duration intervals are wetlands; 2) all forested areas in the indirect impact portion of the Yazoo Study Area are mature forests; and 3) that all of these areas would be considered jurisdictional wetlands. Further, the development of mitigation wetland performance estimates over the period of analysis was based on available data from established mitigation areas in the Yazoo Basin, incorporating information that was previously unavailable and ensuring that impacts to wetland resources can be restored.

Results indicate that Proposed Plan will impact the level of wetland functions, resulting in a decrease of 11,498 AAFCUs. This impact will require the establishment of 2,405 acres of wetland mitigation. Notably, recent research demonstrates that flooding plays a smaller role in wetland hydrodynamics in the Yazoo Study Area than previously understood and that precipitation is the dominant driver of wetland hydrology in much of the Yazoo Basin. As a result, the impacts to wetland functions are not anticipated to convert any wetland area into non-wetlands and the decreases in wetland functions may actually be less than presented herein. Further, the reforestation of 2,700 acres of wetland forests as a nonstructural component of the project will generate 10,667 AAFCUs beyond what is required to offset the anticipated wetland impacts, resulting in a net increase of 2.1% of wetland functions in the Yazoo Study Area.

FIGURES:

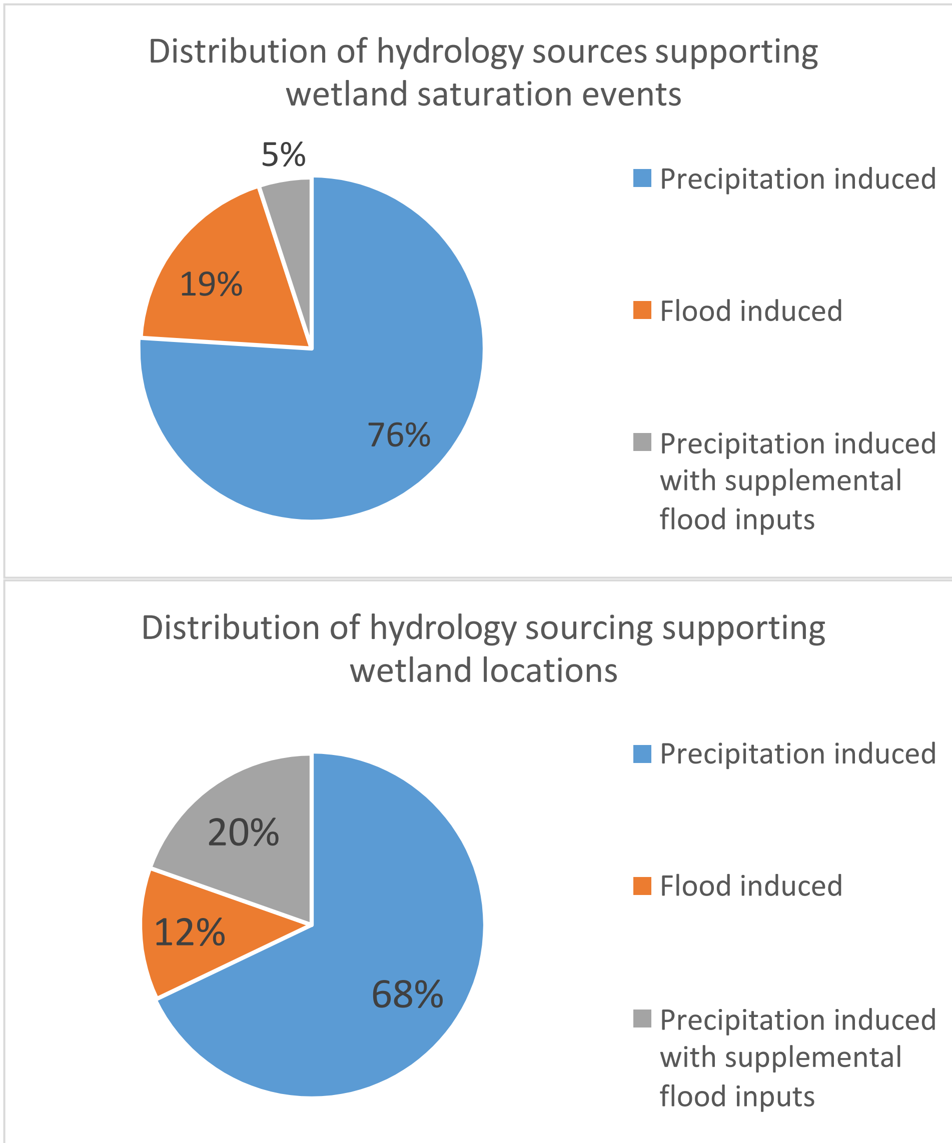

Figure 1. Distribution of hydrologic sources between precipitation, flooding, and precipitation followed by supplemental flooding displayed for wetland hydrology events (n = 95; top panel) and individual wetland locations (n = 56; bottom panel). Note that the majority of wetland saturation events and locations were dominated by precipitation-driven hydrology sources (adapted from Berkowitz et al (2019)).

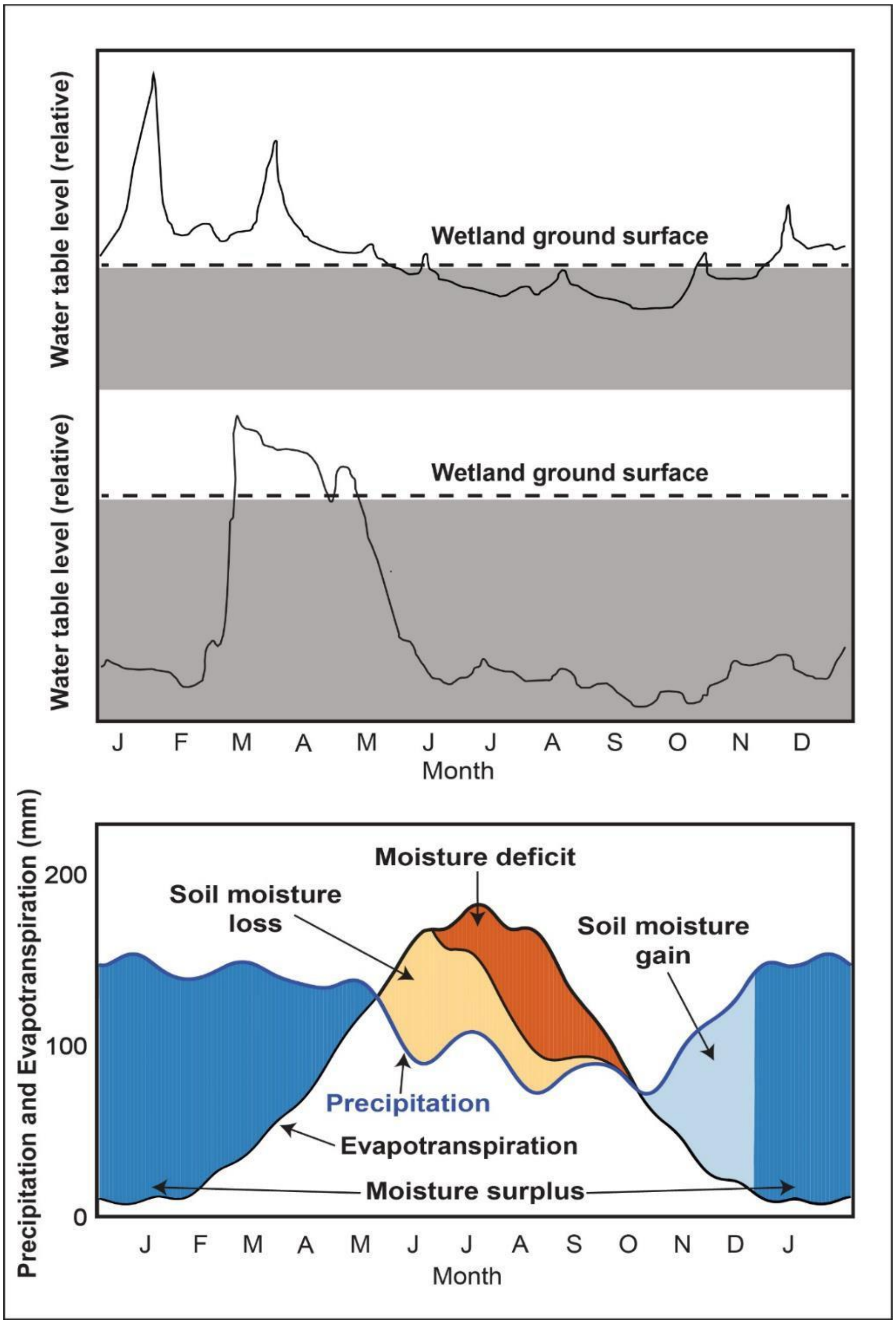

Figure 2. The theoretical hydropatterns for an alluvial swamp forest and hardwood wetland forest (upper panels; adapted from Mitsch and Gosselink 2015). The water balance (lower panel; adapted from data available in Matsuura et al. 2009) corresponds to the theoretical water table fluctuations in the upper panels.

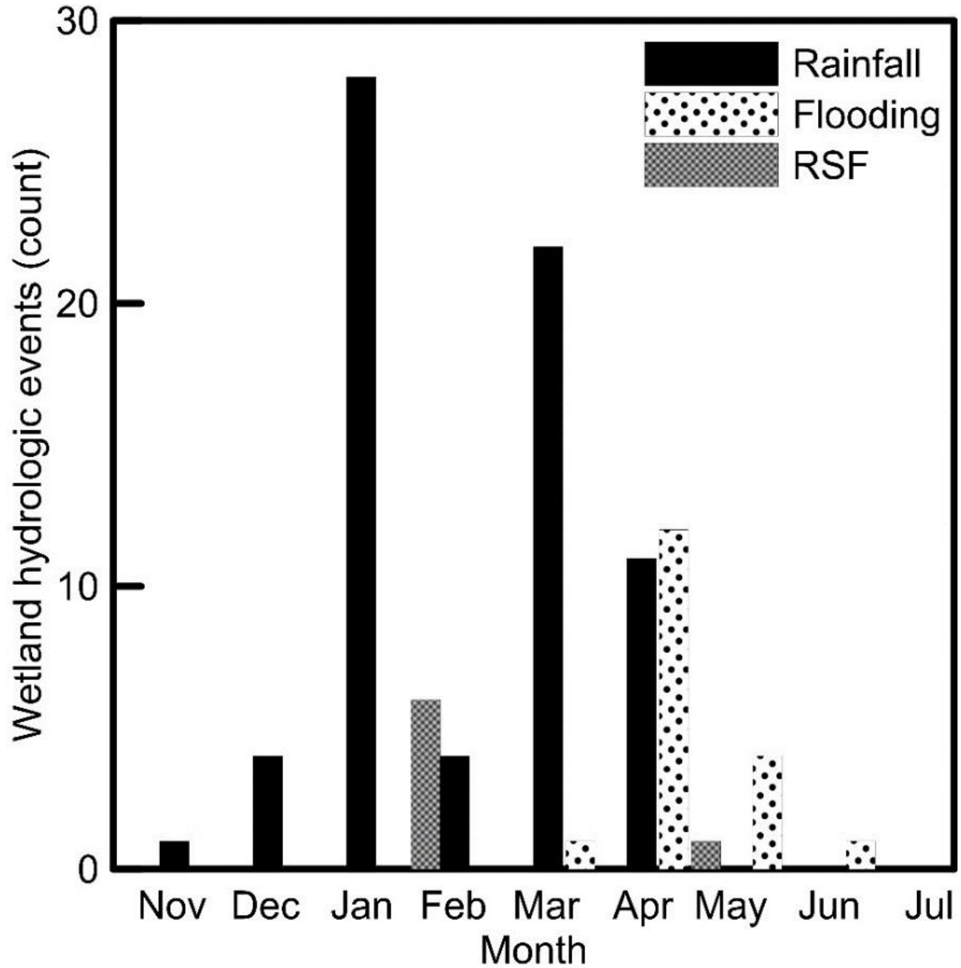

Figure 3. Distribution of saturation event timing and water source. Note that most precipitation (rainfall) driven events dominate the system and began during the winter; while flood-derived events occur during spring and summer. RSF = rainfall followed by supplemental flooding.

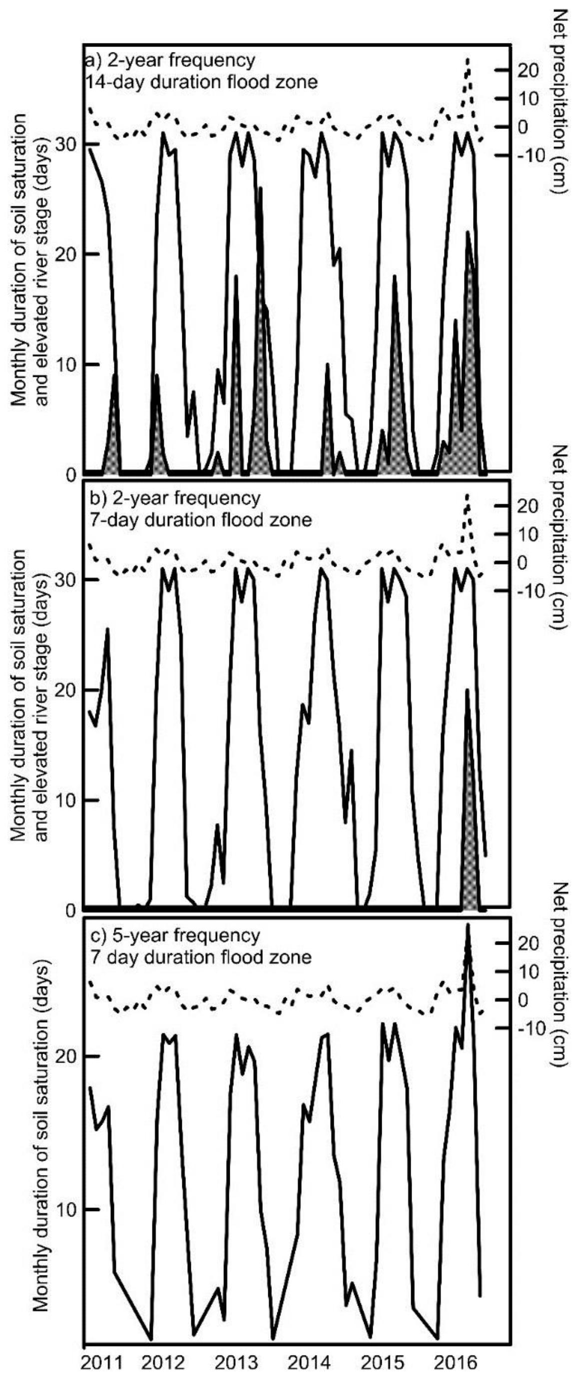

Figure 4. Long-term average monthly duration of soil saturation within ≤30 cm of the soil surface (solid line) and elevated river stage (shaded area) across three mapped flood frequency and duration zones including locations within the a) 2-year frequency, 14-day duration flood zone; b) 2-year frequency, 7-day duration flood zone; and c) 5-year frequency, 7-day duration flood zone (no flooding observed during the monitoring period). Note that the period of soil saturation exceeds the period of elevated river stage in all cases, indicating that precipitation is a major wetland water source in the study area. Net precipitation is also displayed, highlighting the relationship between observed wetland hydropatterns and the seasonal water balance (broken line). Adapted from Berkowitz et al (2019).

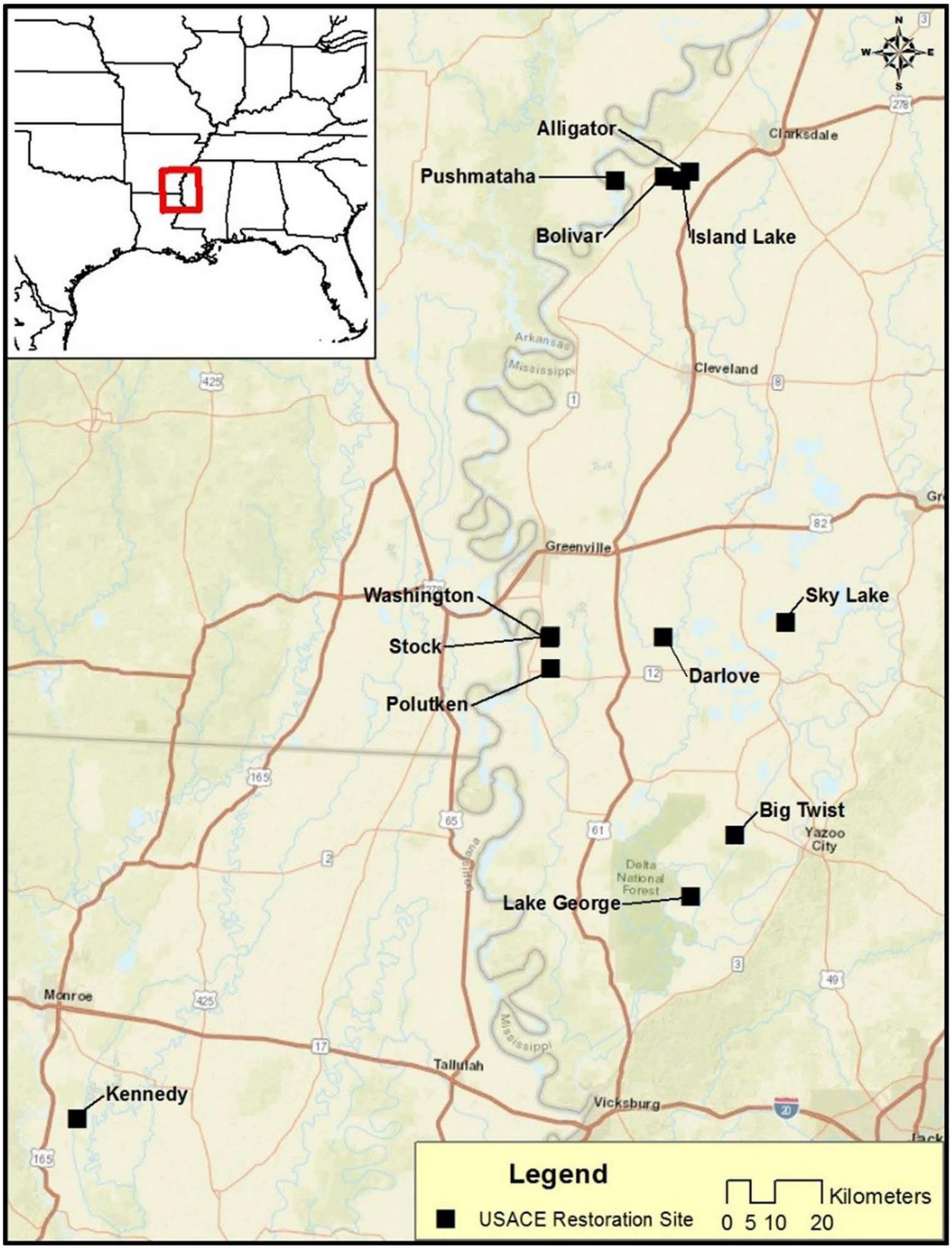

Figure 5. Location of established mitigation areas in the region.

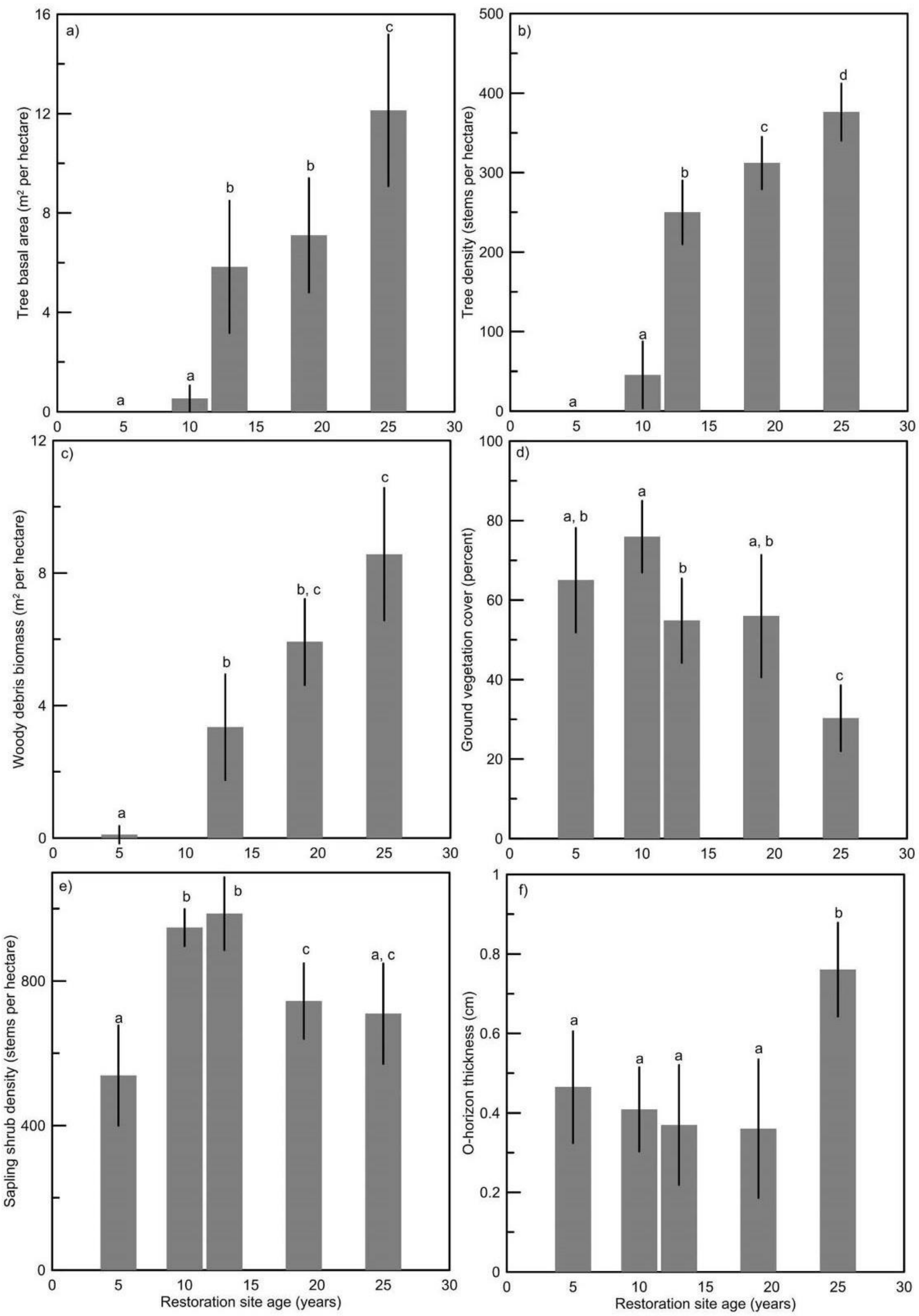

Figure 6. Changes in HGM variable scores over time. Lower case letter indicate significant differences (Berkowitz 2019).

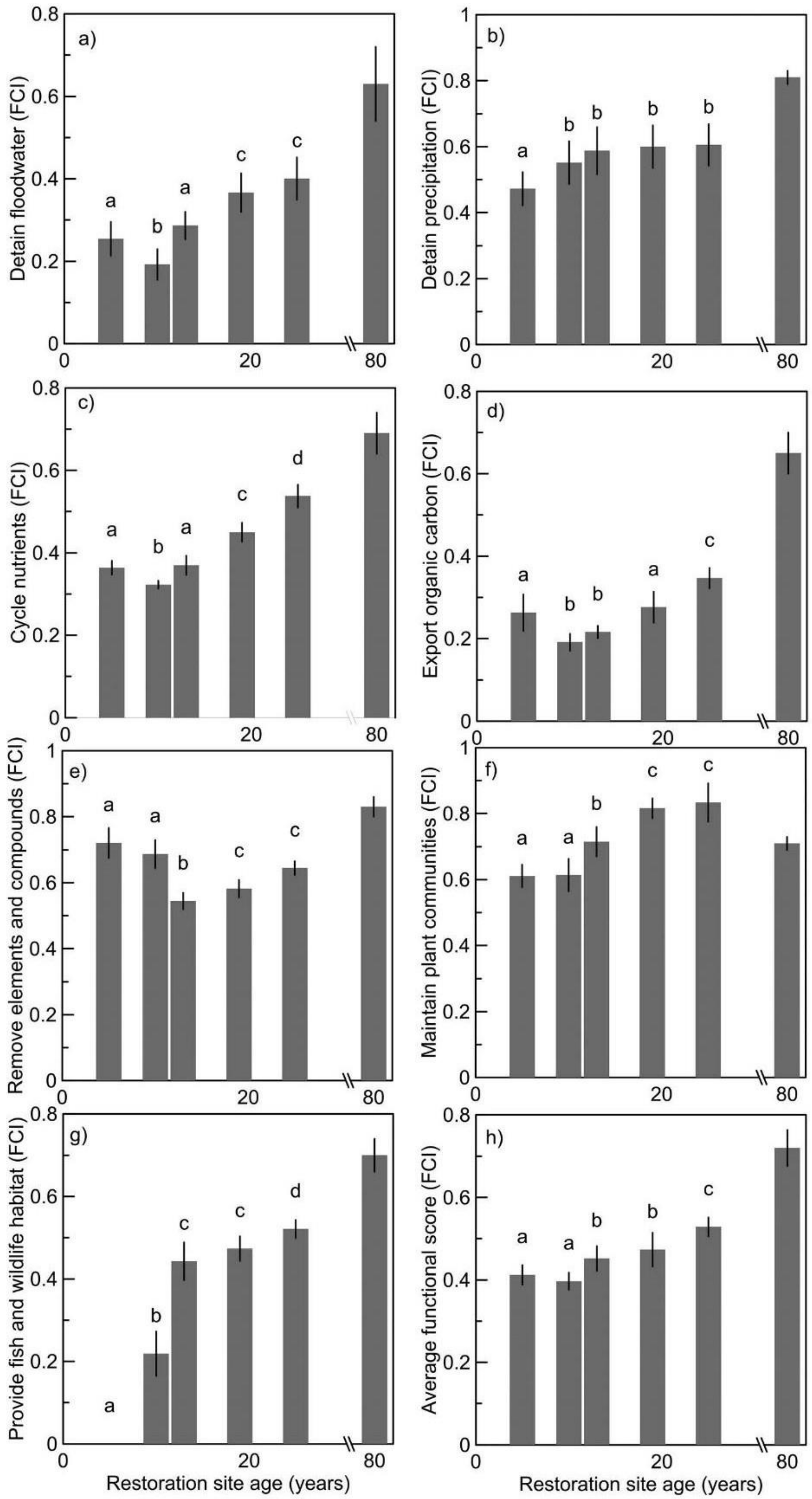

Figure 7. Observed increases in wetland functions over time. Lower case letter indicate statistically significant differences (Berkowitz 2019)

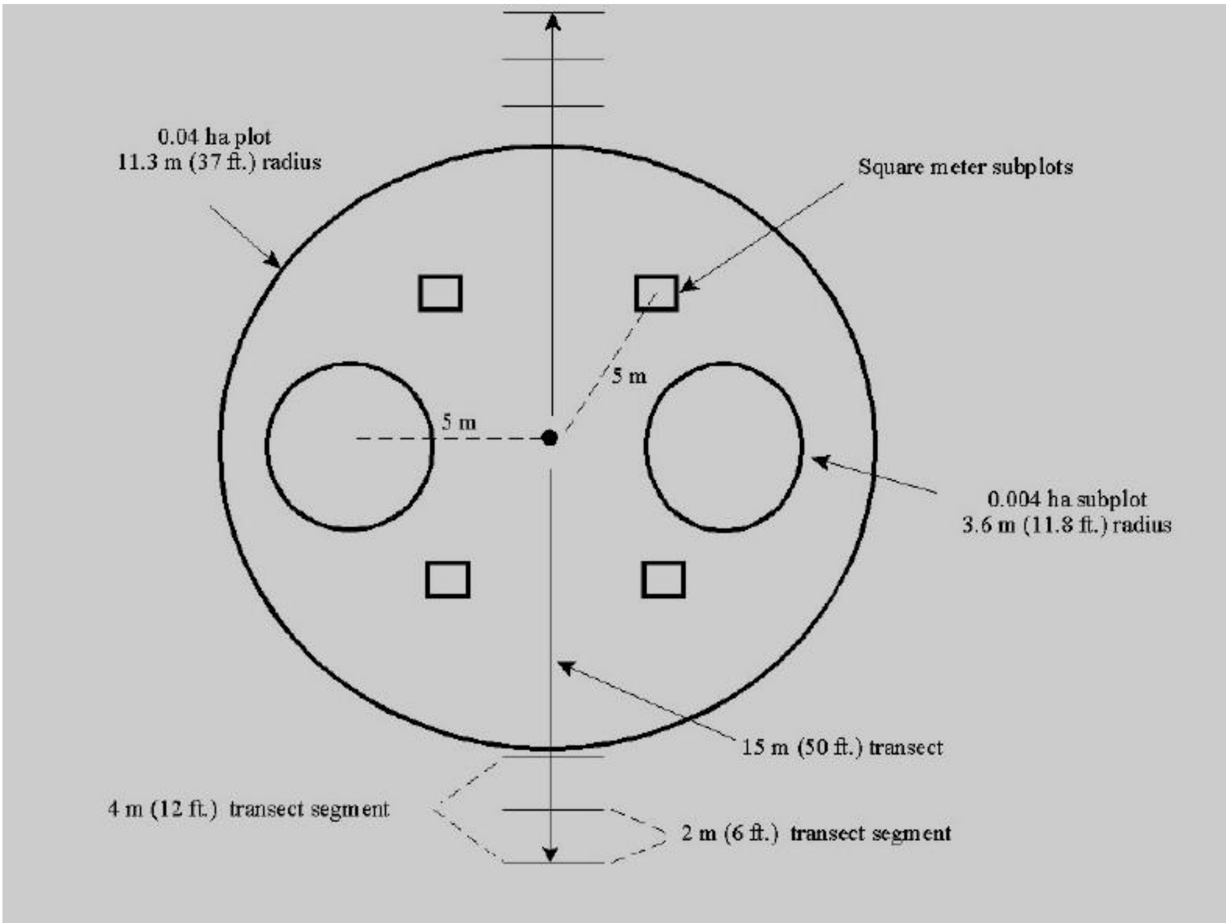

Figure 8 Plot design used for the collection of on-site variables (Smith and Klimas 2002).

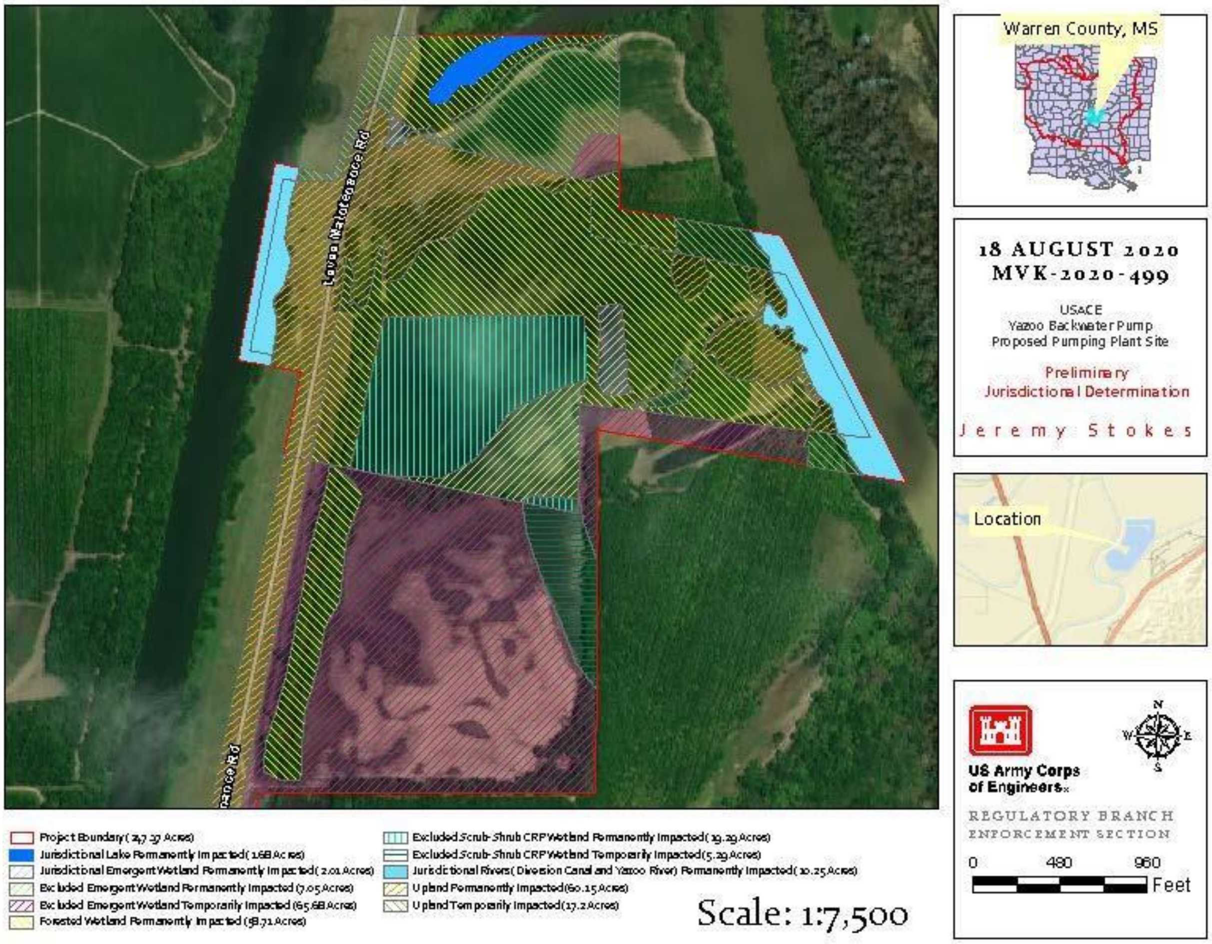

Figure 9 Location map indicating the extent of wetlands at the pump station.

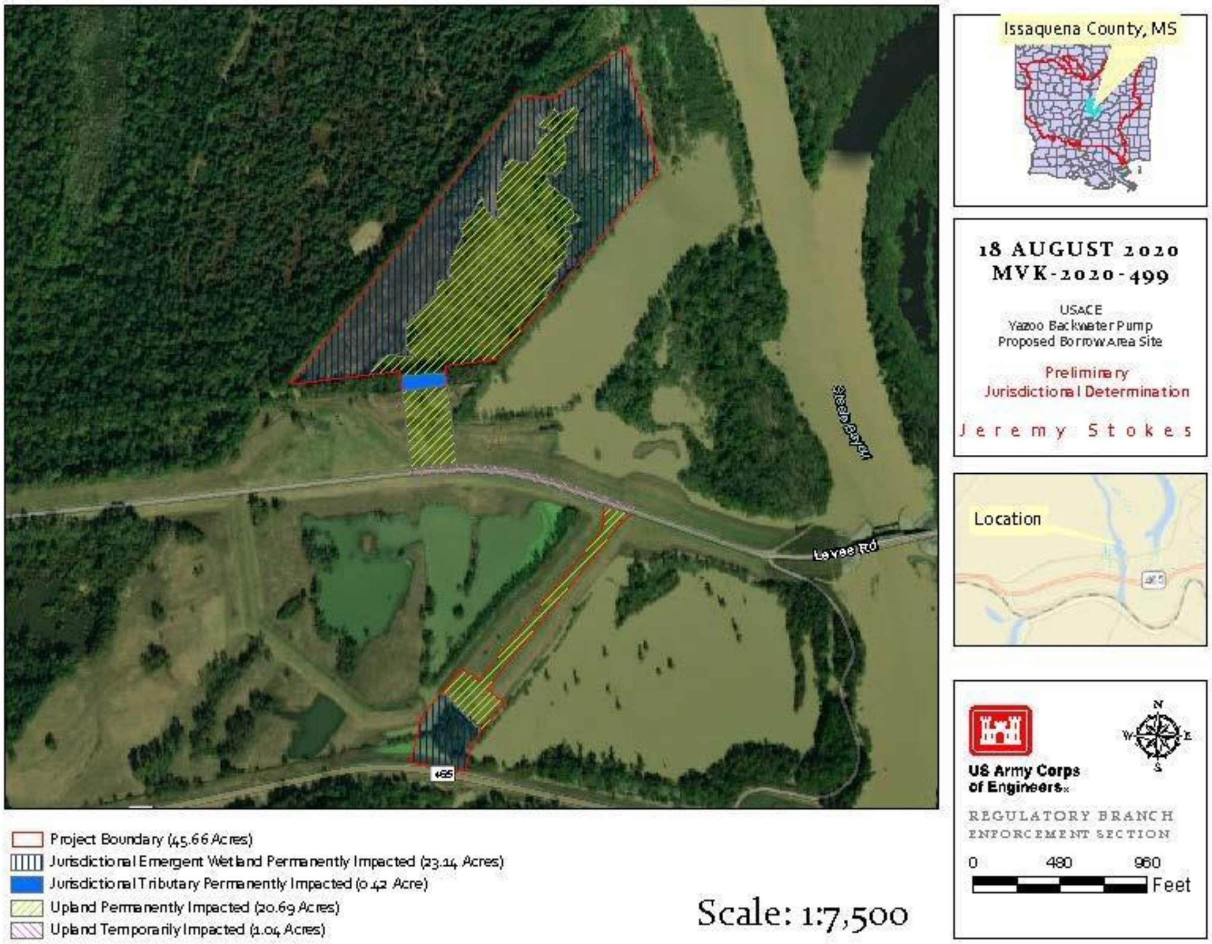

Figure 10 Location map identifying the extent of jurisdictional wetlands at the borrow area.

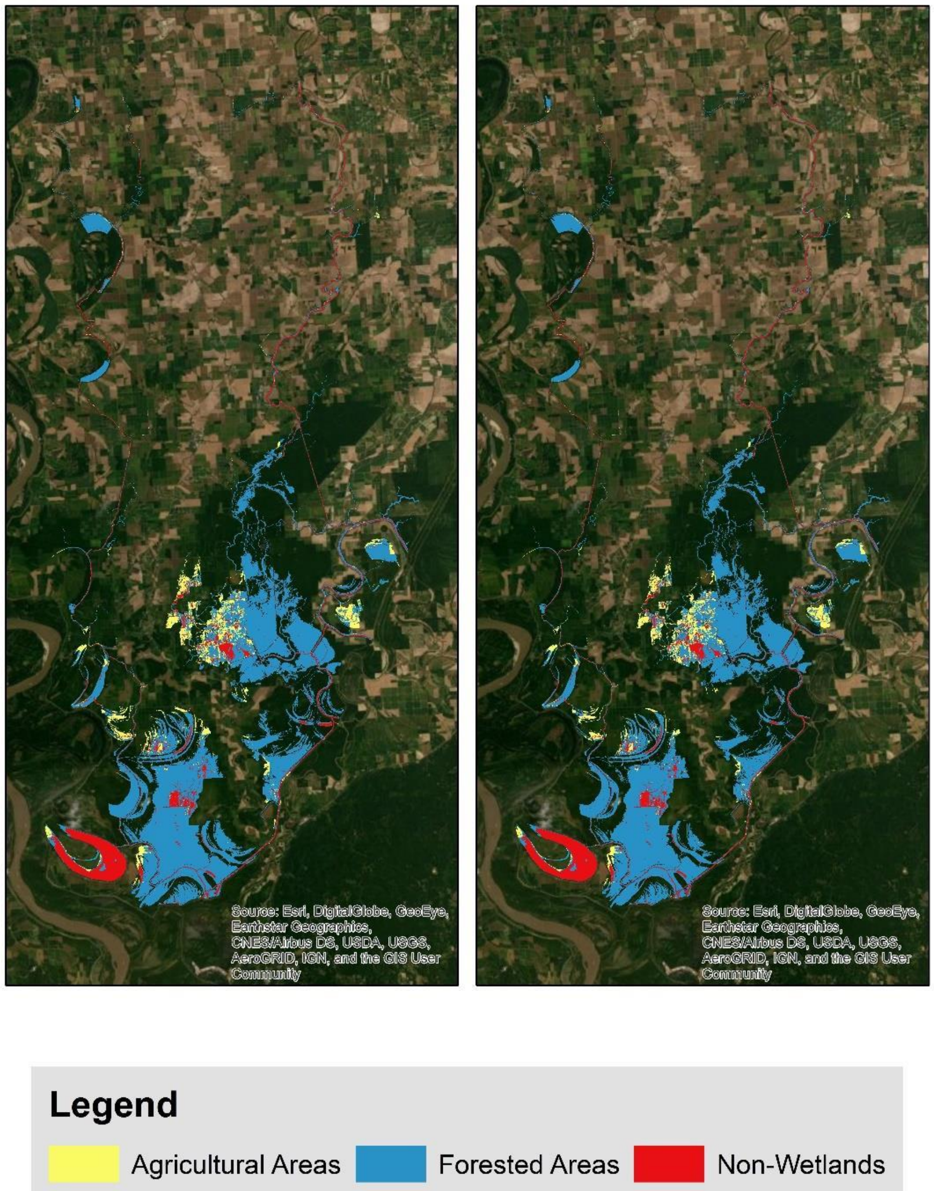

Figure 11 Location of wetland areas in the ≥5.0% flood duration intervals under the No Action (left panel) and Proposed Plan (right panel).

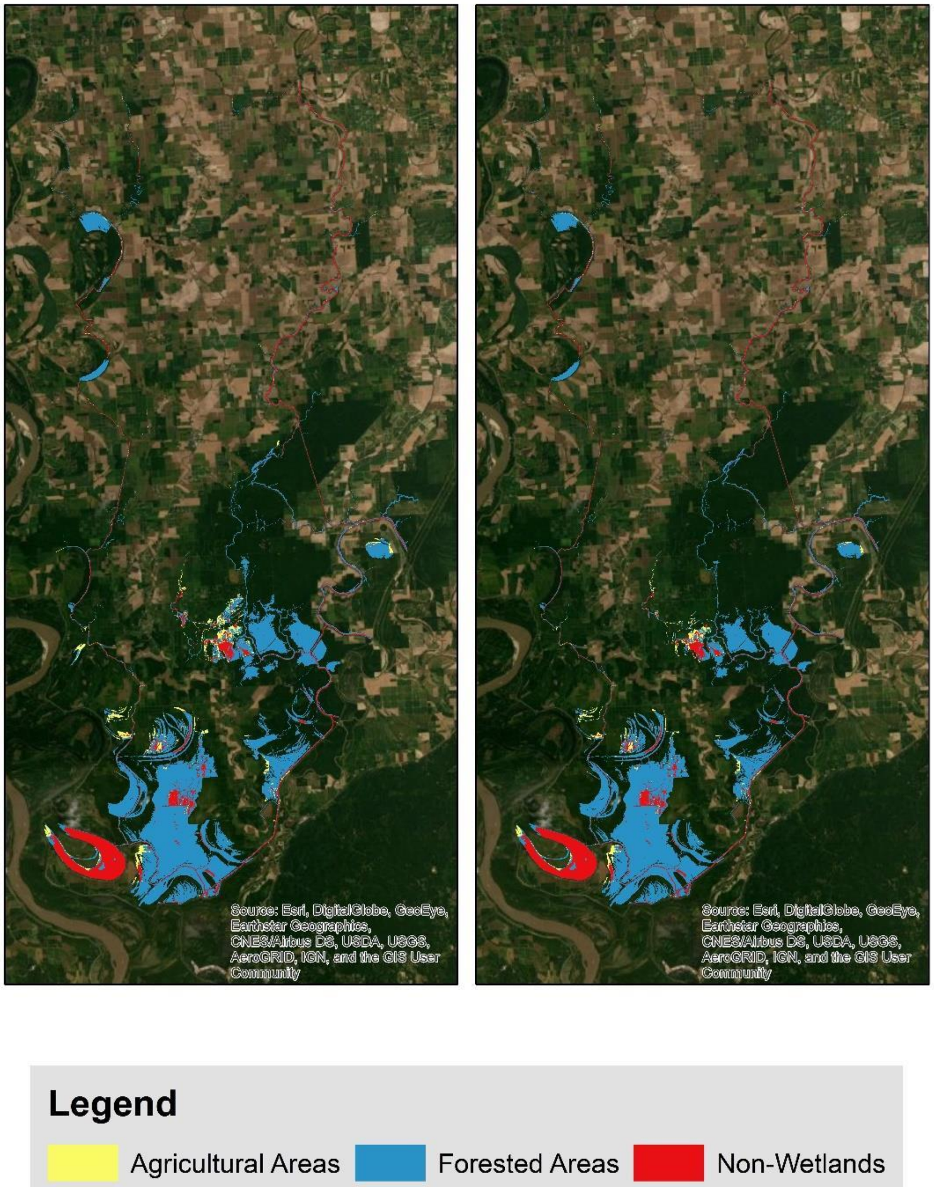

Figure 12 Location of wetland areas in the ≥7.5% flood duration intervals under the No Action (left panel) and Proposed Plan (right panel).

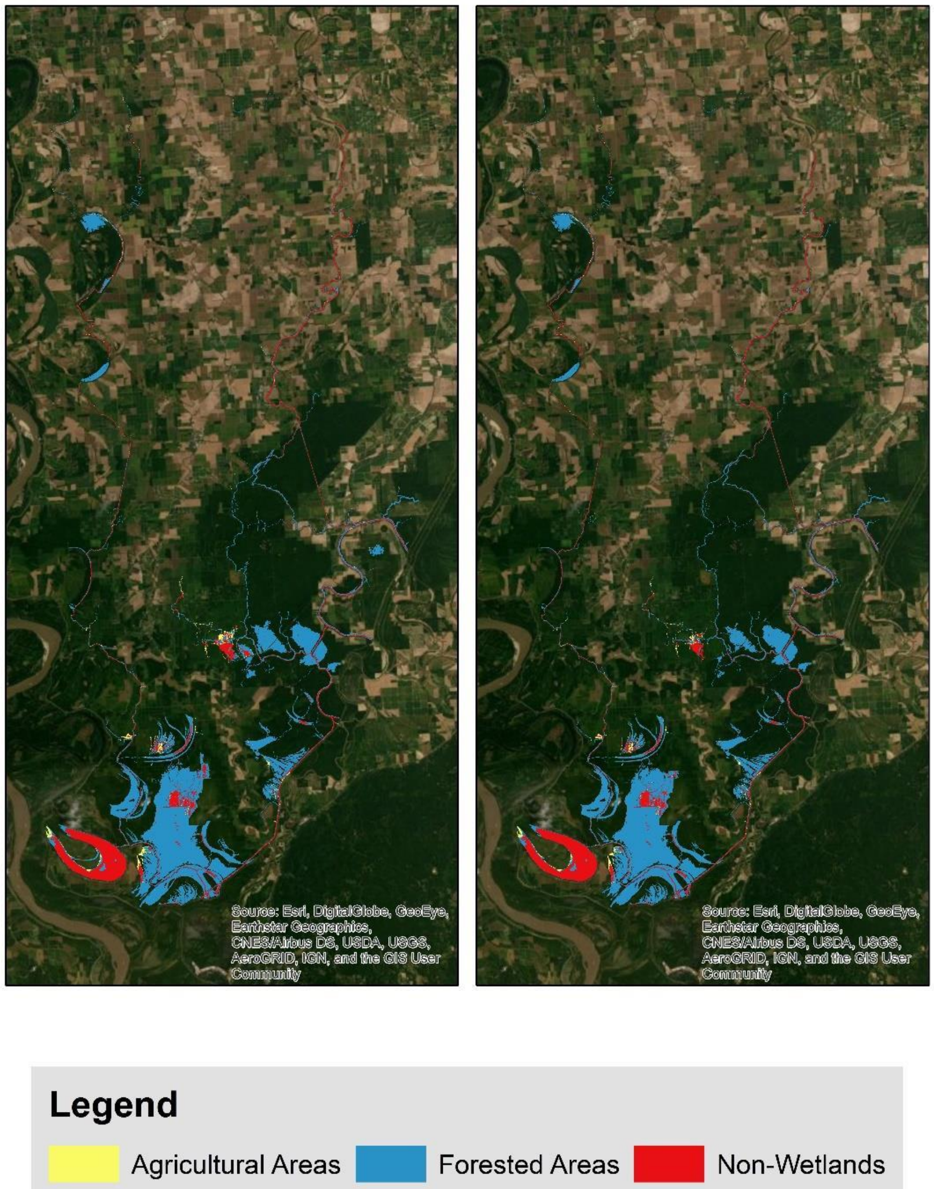

Figure 13 Location of wetland areas in the ≥10% flood duration intervals under the No Action (left panel) and Proposed Plan (right panel).

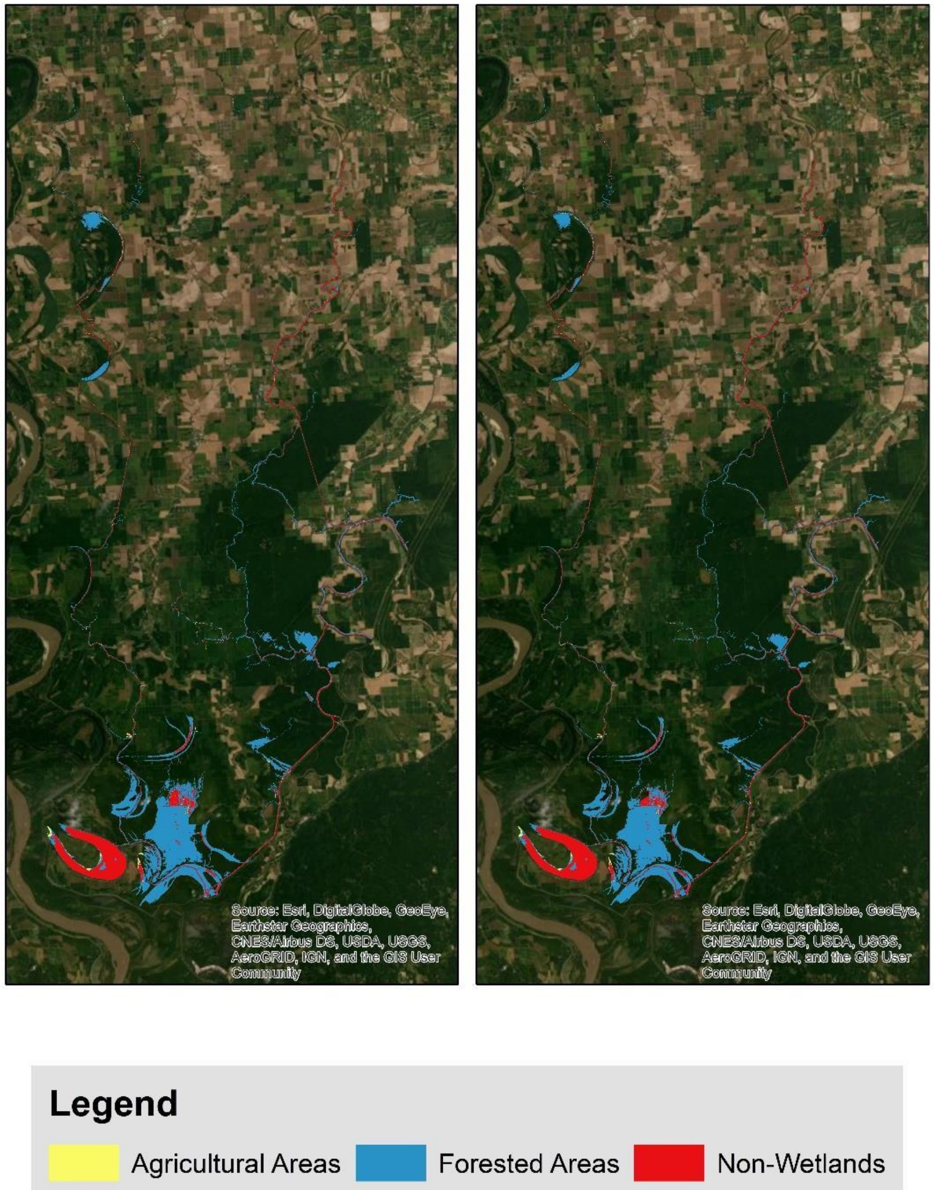

Figure 14 Location of wetland areas in the >12.5% flood duration intervals under the No Action (left panel) and Proposed Plan (right panel).

TABLES:

Table 1. Long-term water table monitoring results from 12 wetland locations. Data includes mapped flood frequency, duration, and the observed annual period of inundation or saturation within ≤30 cm of the soil surface. Note that wetland hydrology was observed at all sites at >50% frequency and the period of high water table surpassed the mapped flood duration regardless of interval. This suggests that precipitation is providing the dominant water source in the forested wetlands evaluated.

Sample location	Mapped flood frequency (years)	Mapped flood duration (days)	Annual period of observed soil saturation (days)								Average annual hydroperiod (days)
			2011	2012	2013	2014	2015	2016	2017	2018	
N	2	>14	159	192	238	179					192
P	2	>14	132	141	155	164	194	125			152
S	2	7-14	156	152	167						158
L	2	7-14	41	133	128	153	179	136			128
H	2	7-14	160	182	231	221	226	157	180		194
J	2	7-14	81	136	150	123					123
R	2	<7	94	90	165	120	126	127	89	101	114
U	2	<7	61	25	76	23	78	81			57
D	2	<7	6	26	158	89	144	124			91
Y	5	<7	109	138	132	37	203	123			124
B	5	<7	6	10	126	69	136	107			76
A	5	<7	0	0	126	51	109	97			64

Table 2 Summary of established USACE mitigation chronosequence (Berkowitz 2019).			
Study location	Size (hectares)	Restoration Age class	Sample plots
Alligator	1,013	13	84
Big Twist	2,692	20	69
Bolivar	344	5	37
Darlove	229	20	29
Island Lake	217	10	21
Kennedy	1,213	5	60
Lake George	3,402	25	124
Polutken	125	20	17
Pushmataha	874	10	40
Sky Lake	1,268	13	65
Stock	330	13	36
Washington	141	13	24
Total	11,847		606

Table 3 Summary of HGM assessment variables, description, and sampling technique applied in the study. Adapted from Smith and Klimas (2002) and Smith and Lin (2007). DBH = Diameter at breast height.

Wetland assessment variable	Description	Sampling technique (units)
1. Wetland tract (V_{TRACT})	Size of contiguous wetland area	Measured using GIS (ha)
2. Core area (V_{CORE})	Portion of wetland within 100m buffer	Measured using GIS (ha)
3. Habitat connectivity ($V_{CONNECT}$)	Proportion of the wetland perimeter connected to suitable forested habitat	Measured using GIS (%)
4. Flood frequency (V_{FREQ})	Flood frequency within the 5-year floodplain	Mapped/modeled flood frequency return interval (years)
5. Flood duration (V_{DUR})	Flood duration interval	Mapped/modeled flood duration interval (% of growing season)
6. Soil integrity (V_{SOIL})	Proportion of the wetland exhibiting altered soils from recent activity	Onsite and GIS assessment of soil disturbance, excavation, fill (%)
7. Cation exchange capacity (V_{CEC})	Change in CEC as indicated by the change in clay soil content	Difference in CEC from soil disturbance, excavation, fill (%)
8. Micro-depressional ponding (V_{POND})	Areas exhibiting small topographic depressions and vernal pool features	Visual estimate of areas capable of ponding water (%)
9. Tree basal area (V_{TBA})	Basal area of all trees ≥10 cm DBH	Measured using calipers within a 0.04 ha plot (m^2/ha)
10. Tree density (V_{TDEN})	Density of all trees ≥10 cm DBH	Count of trees within a 0.04 ha plot (stems/ha)
11. Ground vegetation cover (V_{GVC})	Abundance of ground vegetation cover	Visual estimate of herbaceous and woody vegetation ≤ 1.4 m within 1 m^2 subplots (%)
12. Snags (V_{SNAG})	Density of snags ≥10 cm DBH	Count of trees within a 0.04 ha plot (stems/ha)
13. Vegetation composition (V_{COMP})	Species composition of the tallest stratum	Floristic quality of dominant species (USACE 2010) (weighted average)
14. Tree composition (V_{TCOMP})	Tree species composition of the canopy	Floristic quality of dominant species (USACE 2010) (weighted average)
15. Woody debris biomass (V_{WD})	Abundance of woody debris biomass	Measurement of woody debris biomass along transects (m^3/ha)
16. Log biomass (V_{LOG})	Abundance of log biomass	Measurement of log biomass along transects (m^3/ha)
17. Shrub sapling density (V_{SSD})	Abundance of woody stems <10 cm (4 in.) DBH and >1.2 m in height	Count of stems in 0.004 ha subplots (stems/ha)
18. A horizon biomass (V_{AHOR})	Represents total mass of organic matter in the A soil horizon	Measurement of the A horizon thickness in 1 m^2 subplots (cm)
19. O horizon biomass (V_{OHOR})	Thickness of the soil layer dominated by organic matter	Measurement of the O horizon thickness in 1 m^2 subplots (cm)

Table 4 Wetland functions assessed at each site using the HGM approach. Adapted from Smith and Klimas (2002) and Smith and Lin (2007).

Wetland function	Description	Assessment equation for generating functional capacity index (FCI)
1. Detain Floodwater	Ability to store, convey, and slow floodwaters	$= V_{FREQ}\ x\ [\frac{(V_{LOG} + V_{GVC} + V_{SSD} + V_{TDEN})}{4}]$
2. Detain Precipitation	Capacity to prevent or slow runoff to streams	$FCI = \frac{[V_{POND} + V_{OHOR}]}{2}$
3. Cycle Nutrients	Ability to convert nutrients between organic and inorganic pools	$= \frac{[\frac{(V_{TBA} + V_{SSD} + V_{GVC})}{3} + \frac{(V_{OHOR} + V_{AHOR} + V_{WD} + V_{SNAG})}{4}]}{2}$
4. Export Organic Carbon	Capacity to export dissolved organic carbon downstream	$= \frac{(V_{DUR}\ x2 + V_{FREQ})}{3}$ $x\ \frac{[\frac{(V_{OHOR} + V_{WD} + V_{SNAG})}{3} + \frac{(V_{TBA} + V_{SSD} + V_{GVC})}{3}]}{2}$
5. Physical Removal of Elements and Compounds	Capacity to remove elements and compounds through settling	$= \frac{(V_{DUR}\ x2 + V_{FREQ})}{3}\ x\ V_{POND}$
6. Biological Removal of Elements and Compounds	Capacity to remove elements and compounds by biological processes	$= \frac{(V_{DUR}\ x2 + V_{FREQ})}{3}$ $x\ \frac{[\frac{(V_{OHOR} + V_{WD} + V_{SNAG})}{3} + \frac{(V_{TBA} + V_{SSD} + V_{GVC})}{3}]}{2}$
7. Maintain plant communities	Capacity to develop and maintain characteristic plant communities	$= [\{\frac{[\frac{(V_{TBA} + V_{TDEN})}{2} + V_{COMP}]}{2}\}\ x\ \{\frac{(V_{SOIL} + V_{POND})}{2}\}]^{1/2}$
8. Provide fish and wildlife habitat	Ability to support fish and wildlife species during some portion of their life cycle.	$= [\{\frac{(V_{FREQ} + V_{DUR} + V_{POND})}{3}\}\ x\ \{\frac{(V_{TCOMP} + V_{SNAG} + V_{TBA})}{3}\}\ x\ \{\frac{(V_{LOG} + V_{OHOR})}{2}\}\ x\ \{\frac{(V_{TRACT} + V_{CONNECT} + V_{CORE})}{3}\}]^{1/4}$

Table 5 Mitigation variable inputs, subindex scores, and rationale across target years - V_{TRACT}				
V_{TRACT}	Target year	Metric value	Subindex	Rationale/source
	0	987	0.33	Average tract size (hectares) observed in completed mitigation sites
	5	987	0.33	
	10	987	0.33	
	20	987	0.33	
	35	987	0.33	
	50	987	0.33	

Table 6 Mitigation variable inputs, subindex scores, and rationale across target years - V_{CORE}				
V_{CORE}	Target year	Metric value	Subindex	Rationale/source
	0	49	1	Minimum core area (%) observed in completed mitigation sites
	5	49	1	
	10	49	1	
	20	49	1	
	35	49	1	
	50	49	1	

Table 7 Mitigation variable inputs, subindex scores, and rationale across target years - $V_{CONNECT}$				
$V_{CONNECT}$	Target year	Metric value	Subindex	Rationale/source
	0	50	1	Average connectivity (%) observed in completed mitigation sites
	5	50	1	
	10	50	1	
	20	50	1	
	35	50	1	
	50	50	1	

Table 8 Mitigation variable inputs, subindex scores, and rationale across target years - V_{FREQ}				
V_{FREQ}	Target year	Metric value	Subindex	Rationale/source
	0	4	0.67	Minimum flood frequency (years) observed in completed mitigation sites
	5	4	0.67	
	10	4	0.67	
	20	4	0.67	
	35	4	0.67	
	50	4	0.67	

Table 9 Mitigation variable inputs, subindex scores, and rationale across target years – V_{DUR}				
V_{DUR}	Target year	Metric value	Subindex	Rationale/source
	0	5	0.5	Mitigation sites will display a minimum hydroperiod of 5% of the growing season (14 days) as outlined in USACE (2005)
	10	5	0.5	
	20	5	0.5	
	35	5	0.5	
	50	5	0.5	

Table 10 Mitigation variable inputs, subindex scores, and rationale across target years - V_{SOIL} and V_{CEC}				
V_{SOIL} and V_{CEC}	Target year	Metric value	Subindex	Rationale/source
	0	50	0.5	Soil disturbance (%) is not observed in completed mitigation sites. However, agricultural activities (i.e., furrows) are evident for 0-10 years, then dissipate.
	5	50	0.5	
	10	50	0.5	
	20	0	1	
	35	0	1	
	50	0	1	

Table 11 Mitigation variable inputs, subindex scores, and rationale across target years - V_{POND}				
V_{POND}	Target year	Metric value	Subindex	Rationale/source
	0	45	0.7	Average microdepressional ponding (%) in completed mitigation sites
	5	45	0.7	
	10	45	0.7	
	20	45	0.7	
	35	45	0.7	
	50	45	0.7	

Table 12 Mitigation variable inputs, subindex scores, and rationale across target years - V_{TBA}

V_{TBA}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Average tree basal area (m3/ha) in completed mitigation sites, (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	3	0.16	
	20	10	0.48	
	35	25	1	
	50	30	1	

Table 13 Mitigation variable inputs, subindex scores, and rationale across target years – V_{TDEN}

V_{TDEN}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Average tree density (stems/ha) in completed mitigation sites, (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	147	0.59	
	20	344	1	
	35	725	0.69	
	50	650	0.88	

Table 14 Mitigation variable inputs, subindex scores, and rationale across target years - V_{GVC}

V_{GVC}	Target year	Metric value	Subindex	Rationale/source
	0	0	0.5	Average ground vegetation cover (%) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	65	1	
	10	65	1	
	20	51	1	
	35	43	1	
	50	30	1	

Table 15 Mitigation variable inputs, subindex scores, and rationale across target years - V_{SNAG}

V_{SNAG}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Average snag density (stems/ha) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	1	0.07	
	20	1	0.07	
	35	33	1	
	50	28	1	

Table 16 Mitigation variable inputs, subindex scores, and rationale across target years - V_{COMP} and V_{TCOMP}				
V_{COMP} and V_{TCOMP}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Vegetation composition observed at established mitigation sites (weighted average). Results from selective planting
	5	89	0.89	
	10	93	0.93	
	20	87	0.87	
	35	93	0.93	
	50	93	0.93	

Table 17 Mitigation variable inputs, subindex scores, and rationale across target years - V_{WD}				
V_{WD}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Woody debris biomass (m^3/ha) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	6	0.03	
	20	27	0.11	
	35	38	0.15	
	50	48	0.19	

Table 18 Mitigation variable inputs, subindex scores, and rationale across target years - V_{LOG}				
V_{LOG}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Log biomass (m3/ha) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	5	0.19	
	20	17	0.68	
	35	29	1	
	50	40	1	

Table 19 Mitigation variable inputs, subindex scores, and rationale across target years - V_{SSD}				
V_{SSD}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Shrub sapling density (stems/ha) (%) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	538	0.36	
	10	966	0.64	
	20	727	0.48	
	35	4000	1	
	50	2500	1	

Table 20 Mitigation variable inputs, subindex scores, and rationale across target years - V_{AHOR}				
V_{AHOR}	Target year	Metric value	Subindex	Rationale/source
	0	5	1	A horizon thickness (cm) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	1	0.83	
	10	1	0.85	
	20	1	0.85	
	35	3	1	
	50	3	1	

Table 21 Mitigation variable inputs, subindex scores, and rationale across target years - V_{OHOR}				
V_{OHOR}	Target year	Metric value	Subindex	Rationale/source
	0	0	0.5	O horizon thickness (cm) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0.46	0.62	
	10	0.38	0.6	
	20	0.56	0.64	
	35	2	1	
	50	2	1	

Table 22 HGM functional capacity indexes across target years at mitigation sites					
Function	Target year	FCI	Function	Target year	FCI
Detain Floodwater	0	0.08	Cycle Nutrients	0	0.27
	5	0.23		5	0.41
	10	0.40		10	0.49
	20	0.53		20	0.54
	35	0.61		35	0.89
	50	0.65		50	0.90
Detain Precipitation	0	0.75	Biological Removal of Elements and Compounds	0	0.09
	5	0.81		5	0.18
	10	0.80		10	0.23
	20	0.82		20	0.26
	35	1.00		35	0.48
	50	1.00		50	0.48
Export Organic Carbon	0	0.09	Physical Removal of Elements and Compounds	0	0.56
	5	0.18		5	0.56
	10	0.23		10	0.56
	20	0.26		20	0.56
	35	0.48		35	0.56
	50	0.48		50	0.56
Maintain Plant Communities	0	0.00	Provide Wildlife Habitat	0	0.00
	5	0.58		5	0.48
	10	0.70		10	0.54
	20	0.90		20	0.65
	35	0.94		35	0.86
	50	0.97		50	0.86

Table 23 Determination of AAFCUs across target years for each wetland function at mitigation sites									
Target Year	FCI	Acres	FCU	FCU btw yrs	Target Year	FCI	Acres	FCU	FCU btw yrs
Detain Floodwater					Physical Removal of Elements/Compounds				
0	0.08	1	0.08		0	0.56	1	0.56	
5	0.23	1	0.23	0.77	5	0.56	1	0.56	2.78
10	0.4	1	0.4	1.57	10	0.56	1	0.56	2.78
20	0.53	1	0.53	4.66	20	0.56	1	0.56	5.56
35	0.61	1	0.61	8.57	35	0.56	1	0.56	8.33
50	0.65	1	0.65	9.45	50	0.56	1	0.56	8.33
Sum over 50 years				25.03	Sum over 50 years				27.78
AAFCU				0.5	AAFCU				0.56
Detain Precipitation					Biological Removal of Elements/Compounds				
0	0.75	1	0.75		0	0.09	1	0.09	
5	0.81	1	0.81	3.89	5	0.18	1	0.18	0.69
10	0.8	1	0.8	4.01	10	0.23	1	0.23	1.03
20	0.82	1	0.82	8.09	20	0.26	1	0.26	2.44
35	1	1	1	13.65	35	0.48	1	0.48	5.51
50	1	1	1	15	50	0.48	1	0.48	7.18
Sum over 50 years				44.64	Sum over 50 years				16.85
AAFCU				0.89	AAFCU				0.34
Cycle Nutrients					Maintain Plant Communities				
0	0.27	1	0.27		0	0	1	0	
5	0.41	1	0.41	1.69	5	0.58	1	0.58	1.44
10	0.49	1	0.49	2.25	10	0.7	1	0.7	3.19
20	0.54	1	0.54	5.14	20	0.88	1	0.88	7.91
35	0.89	1	0.89	10.72	35	0.94	1	0.94	13.69
50	0.9	1	0.9	13.45	50	0.97	1	0.97	14.31
Sum over 50 years				33.25	Sum over 50 years				40.54
AAFCU				0.66	AAFCU				0.81
Export Organic Carbon					Provide Wildlife Habitat				
0	0.09	1	0.09		0	0	1	0	
5	0.18	1	0.18	0.69	5	0.48	1	0.48	1.19
10	0.23	1	0.23	1.03	10	0.54	1	0.54	2.54
20	0.26	1	0.26	2.44	20	0.64	1	0.64	5.9
35	0.48	1	0.48	5.51	35	0.86	1	0.86	11.26
50	0.48	1	0.48	7.18	50	0.86	1	0.86	12.90
Sum over 50 years				16.85	Sum over 50 years				33.79
AAFCU				0.34	AAFCU				0.68

Table 24 Summary of AAFCUs generated at mitigation sites across the period of analysis	
Function	AAFCU
Detain Floodwater	0.5
Detain Precipitation	0.89
Cycle Nutrients	0.66
Export Organic Carbon	0.34
Physical Removal of Elements and Compounds	0.56
Biological Removal of Elements and Compounds	0.34
Maintain Plant Communities	0.81
Provide Wildlife Habitat	0.68
Total AAFCUs generated by 1.0 acres of mitigation land	4.78

Table 25 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{TRACT}				
V_{TRACT}	Target year	Metric value	Subindex	Rationale/source
	0	125	0.04	Minimum tract size (hectares) observed in completed mitigation sites
	5	125	0.04	
	10	125	0.04	
	20	125	0.04	
	35	125	0.04	
	50	125	0.04	

Table 26 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{CORE}				
V_{CORE}	Target year	Metric value	Subindex	Rationale/source
	0	49	1	Minimum core area (%) observed in completed mitigation sites
	5	49	1	
	10	49	1	
	20	49	1	
	35	49	1	
	50	49	1	

Table 27 Nonstructural variable inputs, subindex scores, and rationale across target years - $V_{CONNECT}$				
$V_{CONNECT}$	Target year	Metric value	Subindex	Rationale/source
	0	28	0.7	Minimum connectivity (%) observed in completed mitigation sites
	5	28	0.7	
	10	28	0.7	
	20	28	0.7	
	35	28	0.7	
	50	28	0.7	

Table 28 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{FREQ}				
V_{FREQ}	Age	Metric value	Subindex	Rationale/source
	0	4	0.67	Minimum flood frequency (years) observed in completed mitigation sites
	5	4	0.67	
	10	4	0.67	
	20	4	0.67	
	35	4	0.67	
	50	4	0.67	

Table 29 Nonstructural variable inputs, subindex scores, and rationale across target years – V_{DUR}				
V_{DUR}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	The flood duration of nonstructural site locations is unknown
	10	0	0	
	20	0	0	
	35	0	0	
	50	0	0	

Table 30 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{SOIL} and V_{CEC}				
V_{SOIL} and V_{CEC}	Target year	Metric value	Subindex	Rationale/source
	0	50	0.5	Soil disturbance (%) is not observed in completed mitigation sites. However, agricultural activities (i.e., furrows) are evident for 0-10 years, then dissipate.
	5	50	0.5	
	10	50	0.5	
	20	0	1	
	35	0	1	
	50	0	1	

Table 31 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{POND}				
V_{POND}	Target year	Metric value	Subindex	Rationale/source
	0	45	0.7	Average microdepressional ponding (%) in completed mitigation sites
	5	45	0.7	
	10	45	0.7	
	20	45	0.7	
	35	45	0.7	
	50	45	0.7	

Table 32 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{TBA}				
V_{TBA}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Average tree basal area (m3/ha) in completed mitigation sites, (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	3	0.16	
	20	10	0.48	
	35	25	1	
	50	30	1	

Table 33 Nonstructural variable inputs, subindex scores, and rationale across target years – V_{TDEN}				
V_{TDEN}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Average tree density (stems/ha) in completed mitigation sites, (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	147	0.59	
	20	344	1	
	35	725	0.69	
	50	650	0.88	

Table 34 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{GVC}				
V_{GVC}	Target year	Metric value	Subindex	Rationale/source
	0	0	0.5	Average ground vegetation cover (%) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	65	1	
	10	65	1	
	20	51	1	
	35	43	1	
	50	30	1	

Table 35 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{SNAG}				
V_{SNAG}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Average snag density (stems/ha) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	1	0.07	
	20	1	0.07	
	35	33	1	
	50	28	1	

Table 36 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{COMP} and V_{TCOMP}				
V_{COMP} and V_{TCOMP}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Vegetation composition observed at established mitigation sites (weighted average). Results from selective planting
	5	89	0.89	
	10	93	0.93	
	20	87	0.87	
	35	93	0.93	
	50	93	0.93	

Table 37 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{WD}				
V_{WD}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Woody debris biomass (m^3/ha) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	6	0.03	
	20	27	0.11	
	35	38	0.15	
	50	48	0.19	

Table 38 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{LOG}				
V_{LOG}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Log biomass (m3/ha) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0	0	
	10	5	0.19	
	20	17	0.68	
	35	29	1	
	50	40	1	

Table 39 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{SSD}				
V_{SSD}	Target year	Metric value	Subindex	Rationale/source
	0	0	0	Shrub sapling density (stems/ha) (%) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	538	0.36	
	10	966	0.64	
	20	727	0.48	
	35	4000	1	
	50	2500	1	

Table 40 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{AHOR}				
V_{AHOR}	Target year	Metric value	Subindex	Rationale/source
	0	5	1	A horizon thickness (cm) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	1	0.83	
	10	1	0.85	
	20	1	0.85	
	35	3	1	
	50	3	1	

Table 41 Nonstructural variable inputs, subindex scores, and rationale across target years - V_{OHOR}				
V_{OHOR}	Target year	Metric value	Subindex	Rationale/source
	0	0	0.5	O horizon thickness (cm) observed in completed mitigation sites (0-20 years). Values for >20 years predicted by Smith and Klimas (2002)
	5	0.46	0.62	
	10	0.38	0.6	
	20	0.56	0.64	
	35	2	1	
	50	2	1	

Table 42 Nonstructural HGM functional capacity indexes across target years					
Function	Target year	FCI	Function	Target year	FCI
Detain Floodwater	0	0.08	Cycle Nutrients	0	0.27
	5	0.23		5	0.41
	10	0.40		10	0.49
	20	0.53		20	0.54
	35	0.61		35	0.89
	50	0.65		50	0.90
Detain Precipitation	0	0.75	Biological Removal of Elements and Compounds	0	0.04
	5	0.81		5	0.07
	10	0.80		10	0.09
	20	0.82		20	0.10
	35	1.00		35	0.19
	50	1.00		50	0.19
Export Organic Carbon	0	0.04	Physical Removal of Elements and Compounds	0	0.22
	5	0.07		5	0.22
	10	0.09		10	0.22
	20	0.10		20	0.22
	35	0.19		35	0.22
	50	0.19		50	0.22
Maintain Plant Communities	0	0.00	Provide Wildlife Habitat	0	0.00
	5	0.58		5	0.41
	10	0.70		10	0.47
	20	0.90		20	0.56
	35	0.94		35	0.75
	50	0.97		50	0.75

Table 43 Determination of nonstructural AAFCUs across target years for each wetland function									
Target Year	FCI	Acres	FCU	FCU between years	Target Year	FCI	Acres	FCU	FCU between years
Detain Floodwater					Physical Removal of Elements and Compounds				
0	0.08	1	0.08		0	0.22	1	0.22	
5	0.23	1	0.23	0.77	5	0.22	1	0.22	1.11
10	0.40	1	0.40	1.57	10	0.22	1	0.22	1.11
20	0.53	1	0.53	4.66	20	0.22	1	0.22	2.22
35	0.61	1	0.61	8.57	35	0.22	1	0.22	3.33
50	0.65	1	0.65	9.45	50	0.22	1	0.22	3.33
Sum over 50 years				25.03	Sum over 50 years				11.11
AAFCU				0.50	AAFCU				0.22
Detain Precipitation					Biological Removal of Elements/Compounds				
0	0.75	1	0.75		0	0.04	1	0.04	
5	0.81	1	0.81	3.89	5	0.07	1	0.07	0.28
10	0.80	1	0.80	4.01	10	0.09	1	0.09	0.41
20	0.82	1	0.82	8.09	20	0.10	1	0.10	0.98
35	1.00	1	1.00	13.65	35	0.19	1	0.19	2.20
50	1.00	1	1.00	15.00	50	0.19	1	0.19	2.87
Sum over 50 years				44.64	Sum over 50 years				6.74
AAFCU				0.89	AAFCU				0.13
Cycle Nutrients					Maintain Plant Communities				
0	0.27	1	0.27		0	0.00	1	0.00	
5	0.41	1	0.41	1.69	5	0.58	1	0.58	1.44
10	0.49	1	0.49	2.25	10	0.70	1	0.70	3.19
20	0.54	1	0.54	5.14	20	0.90	1	0.90	7.98
35	0.89	1	0.89	10.72	35	0.94	1	0.94	13.79
50	0.90	1	0.90	13.45	50	0.97	1	0.97	14.31
Sum over 50 years				33.25	Sum over 50 years				40.72
AAFCU				0.66	AAFCU				0.81
Export Organic Carbon					Provide Wildlife Habitat				
0	0.04	1	0.04		0	0.00	1	0.00	
5	0.07	1	0.07	0.28	5	0.41	1	0.41	1.04
10	0.09	1	0.09	0.41	10	0.47	1	0.47	2.21
20	0.10	1	0.10	0.98	20	0.56	1	0.56	5.16
35	0.19	1	0.19	2.20	35	0.75	1	0.75	9.85
50	0.19	1	0.19	2.87	50	0.75	1	0.75	11.24
Sum over 50 years				6.74	Sum over 50 years				29.49
AAFCU				0.13	AAFCU				0.59

Table 44 Summary of nonstructural AAFCU results across the period of analysis	
Function	AAFCU
Detain Floodwater	0.50
Detain Precipitation	0.89
Cycle Nutrients	0.66
Export Organic Carbon	0.13
Physical Removal of Elements and Compounds	0.22
Biological Removal of Elements and Compounds	0.13
Maintain Plant Communities	0.81
Provide Wildlife Habitat	0.59
Total AAFCUs generated by 1.0 acres of nonstructural land	3.95

Table 45 Distribution of jurisdictional wetlands and non-wetlands within the direct impact area (acres)				
Location	Land cover classification			
	Mature Forested	Agricultural	Non-wetlands	Total
Borrow area	0	23	23	46
Pump station	59	5	184	247
Total	59	28	206	293

Table 46 HGM variable metric inputs and variable subindex scores for areas in the direct impact area				
	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000	1.00	3,000	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,388	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	12.50	0.69	12.50	0.69

Table 47 HGM functional scores for areas within the direct impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.98	0.25
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.74	0.20
Physical Removal of Elements and Compounds	0.62	0.49
Biological Removal of Elements and Compounds	0.74	0.20
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.93	0.00

Table 48 Determination of AAFCUs across land cover classifications within the direct impact area under the No Action Alternative						
	Mature Forest					
		Borrow Area		Pump station		
Function	FCI	Acres	AAFCU	Acres	AAFCU	Total AAFCUs
Detain Floodwater	0.98	0	0	59	58	58
Detain Precipitation	0.83	0	0	59	49	49
Cycle Nutrients	0.95	0	0	59	56	56
Export Organic Carbon	0.74	0	0	59	43	43
Physical Removal of Elements and Compounds	0.62	0	0	59	36	36
Biological Removal of Elements and Compounds	0.74	0	0	59	43	43
Maintain Plant Communities	0.93	0	0	59	54	55
Provide Wildlife Habitat	0.93	0	0	59	55	55
	Agricultural					
		Borrow Area		Pump station		
Function	FCI	Acres	AAFCU	Acres	AAFCU	Total AAFCUs
Detain Floodwater	0.25	23	6	2	0	6
Detain Precipitation	0.56	23	13	2	1	14
Cycle Nutrients	0.29	23	7	2	1	7
Export Organic Carbon	0.20	23	5	2	0	5
Physical Removal of Elements and Compounds	0.49	23	11	2	1	12
Biological Removal of Elements and Compounds	0.20	23	5	2	0	5
Maintain Plant Communities	0.00	23	0	2	0	0
Provide Wildlife Habitat	0.00	23	0	2	0	0
Total AAFCUs			46		398	444

Table 49 Distribution of land cover classes and flood duration intervals within the Yazoo Study Area under the No Action Alternative					
Land cover classification	Flood duration interval (% of the growing season)				
	5-7.5%	7.5-10%	10.5-12.5%	>12.5%	Total
Forested wetlands	21,252	13,882	14,554	24,522	74,211
Agricultural croplands	5,182	2,194	771	623	8,770
Non-wetlands	1,403	1,017	1,539	10,737	14,696
Total	27,838	17,092	16,864	35,882	97,677

Table 50 HGM variable metric inputs and variable subindex scores for the 0.0% flood duration interval in the indirect impact area				
	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000.00	1.00	3,000.00	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,389.00	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	0.00	0.00	0.00	0.00

Table 51 HGM functional scores for areas for the 0.0% flood duration interval in the indirect impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.82	0.21
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.26	0.07
Physical Removal of Elements and Compounds	0.22	0.17
Biological Removal of Elements and Compounds	0.26	0.07
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.84	0.00

Table 52 HGM variable metric inputs and variable subindex scores for the 0.0-2.5% flood duration interval in the indirect impact area				
	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000	1.00	3,000	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,389	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	1.25	0.13	1.25	0.13

Table 53 HGM functional scores for areas for the 0.0-2.5% flood duration interval in the indirect impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.98	0.25
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.39	0.10
Physical Removal of Elements and Compounds	0.32	0.26
Biological Removal of Elements and Compounds	0.39	0.10
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.87	0.00

Table 54 HGM variable metric inputs and variable subindex scores for the 2.5-5.0% flood duration interval in the indirect impact area				
	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000	1.00	3,000	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,389	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	3.75	0.38	3.75	0.38

Table 55 HGM functional scores for the 2.5-5.0% flood duration interval in the indirect impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.98	0.25
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.55	0.15
Physical Removal of Elements and Compounds	0.45	0.36
Biological Removal of Elements and Compounds	0.55	0.15
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.90	0.00

Table 56 HGM variable metric inputs and variable subindex scores for the 5.0-7.5% flood duration interval in the indirect impact area				
	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000	1.00	3,000	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,389	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	6.25	0.53	6.25	0.53

Table 57 HGM functional scores for the 5.0-7.5% flood duration interval in the indirect impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.98	0.25
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.64	0.17
Physical Removal of Elements and Compounds	0.53	0.43
Biological Removal of Elements and Compounds	0.64	0.17
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.92	0.00

Table 58 HGM variable metric inputs and variable subindex scores for the 7.5-10% flood duration interval in the indirect impact area				
	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000	1.00	3,000	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,389	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	8.75	0.59	8.75	0.59

Table 59 HGM functional scores for the 7.5-10% flood duration interval in the indirect impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.98	0.25
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.68	0.18
Physical Removal of Elements and Compounds	0.57	0.46
Biological Removal of Elements and Compounds	0.68	0.18
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.92	0.00

Table 60 HGM variable metric inputs and variable subindex scores for the 10-12.5% flood duration interval in the indirect impact area

	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000	1.00	3,000	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,389	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	11.25	0.66	11.25	0.66

Table 61 HGM functional scores for areas for the 10-12.5% flood duration interval in the indirect impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.98	0.25
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.72	0.19
Physical Removal of Elements and Compounds	0.60	0.48
Biological Removal of Elements and Compounds	0.72	0.19
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.93	0.00

Table 62 HGM variable metric inputs and variable subindex scores for the >12.5% flood duration interval in the indirect impact area				
	Land cover classification			
	Mature Forest		Agricultural	
Variable	Metric Value	Subindex	Metric Value	Subindex
1. V_{TRACT}	3,000	1.00	3,000	1.00
2. V_{CORE}	50.00	1.00	50.00	1.00
3. $V_{CONNECT}$	50.00	1.00	50.00	1.00
4. V_{FREQ}	2.00	1.00	2.00	1.00
5. V_{POND}	31.08	0.78	25.00	0.63
6. V_{SOIL}	0.00	1.00	50.00	0.50
7. V_{CEC}	0.00	1.00	50.00	0.50
8. V_{TBA}	27.98	1.00	0.00	0.00
9. V_{TDEN}	339.00	1.00	0.00	0.00
10. V_{SNAG}	46.63	1.00	0.00	0.00
11. V_{TCOMP}	93.00	0.93	0.00	0.00
12. V_{COMP}	93.00	0.93	0.00	0.00
13. V_{WD}	206.14	0.82	0.00	0.00
14. V_{LOG}	67.23	1.00	0.00	0.00
15. V_{SSD}	1,389	0.93	0.00	0.00
16. V_{GVC}	14.18	1.00	25.00	1.00
17. V_{OHOR}	1.51	0.88	0.00	0.50
18. V_{AHOR}	5.00	1.00	10.00	0.50
19. V_{DUR}	12.50	0.69	12.50	0.69

Table 63 HGM functional scores for the >12.5% flood duration interval of the indirect impact area		
	Land cover classification	
Function	Mature Forest	Agricultural
Detain Floodwater	0.98	0.25
Detain Precipitation	0.83	0.56
Cycle Nutrients	0.95	0.29
Export Organic Carbon	0.74	0.20
Physical Removal of Elements and Compounds	0.62	0.49
Biological Removal of Elements and Compounds	0.74	0.20
Maintain Plant Communities	0.93	0.00
Provide Wildlife Habitat	0.93	0.00

Table 64 Summary of FCI values across flood duration intervals within the indirect impact area under the No Action Alternative			
	Mature Forest		
Function	Mean	Minimum	Maximum
Detain Floodwater	0.96	0.82	0.98
Detain Precipitation	0.83	0.83	0.83
Cycle Nutrients	0.95	0.95	0.95
Export Organic Carbon	0.57	0.26	0.74
Physical Removal of Elements and Compounds	0.47	0.22	0.62
Biological Removal of Elements and Compounds	0.57	0.26	0.74
Maintain Plant Communities	0.93	0.93	0.93
Provide Wildlife Habitat	0.90	0.84	0.93
	Agricultural		
Detain Floodwater	0.24	0.21	0.25
Detain Precipitation	0.56	0.56	0.56
Cycle Nutrients	0.29	0.29	0.29
Export Organic Carbon	0.15	0.07	0.20
Physical Removal of Elements and Compounds	0.38	0.17	0.49
Biological Removal of Elements and Compounds	0.15	0.07	0.20
Maintain Plant Communities	0.00	0.00	0.00
Provide Wildlife Habitat	0.00	0.00	0.00

Table 65 Determination of AAFCUs in the indirect impact area across land cover classifications and flood duration intervals under the No Action Alternative						
Function	FCI		Extent (acres)		AAFCU	
	MF	AG	MF	AG	MF	AG
5-7.5%						
Detain Floodwater	0.98	0.25	21,252	5,182	20,853	1,296
Detain Precipitation	0.83	0.56	21,252	5,182	17,584	2,915
Cycle Nutrients	0.95	0.29	21,252	5,182	20,196	1,512
Export Organic Carbon	0.64	0.17	21,252	5,182	13,703	891
Physical Removal of Elements/Compounds	0.53	0.43	21,252	5,182	11,354	2,227
Biological Removal of Elements/Compounds	0.64	0.17	21,252	5,182	13,703	891
Maintain Plant Communities	0.93	0.00	21,252	5,182	19,679	0
Provide Wildlife Habitat	0.92	0.00	21,252	5,182	19,478	0
Total					136,551	9,730
7.5-10%						
Detain Floodwater	0.98	0.25	13,882	2,194	13,622	548
Detain Precipitation	0.83	0.56	13,882	2,194	11,486	1,234
Cycle Nutrients	0.95	0.29	13,882	2,194	13,192	640
Export Organic Carbon	0.68	0.18	13,882	2,194	9,494	400
Physical Removal of Elements/Compounds	0.57	0.46	13,882	2,194	7,866	1,000
Biological Removal of Elements/Compounds	0.68	0.18	13,882	2,194	9,494	400
Maintain Plant Communities	0.93	0.00	13,882	2,194	12,855	0
Provide Wildlife Habitat	0.92	0.00	13,882	2,194	12,808	0
Total					90,816	4,222
10-12.5%						
Detain Floodwater	0.98	0.25	14,554	771	14,281	193
Detain Precipitation	0.83	0.56	14,554	771	12,042	434
Cycle Nutrients	0.95	0.29	14,554	771	13,831	225
Export Organic Carbon	0.72	0.19	14,554	771	10,522	149
Physical Removal of Elements/Compounds	0.60	0.48	14,554	771	8,718	371
Biological Removal of Elements/Compounds	0.72	0.19	14,554	771	10,522	149
Maintain Plant Communities	0.93	0.00	14,554	771	13,477	0
Provide Wildlife Habitat	0.93	0.00	14,554	771	13,516	0
Total					96,907	1,520
>12.5%						
Detain Floodwater	0.98	0.25	24,522	623	24,062	156
Detain Precipitation	0.83	0.56	24,522	623	20,290	350
Cycle Nutrients	0.95	0.29	24,522	623	23,303	182
Export Organic Carbon	0.74	0.20	24,522	623	18,207	123
Physical Removal of Elements/Compounds	0.62	0.49	24,522	623	15,086	308

Biological Removal of Elements/Compounds	0.74	0.20	24,522	623	18,207	123
Maintain Plant Communities	0.93	0.00	24,522	623	22,707	0
Provide Wildlife Habitat	0.93	0.00	24,522	623	22,846	0
Total			24,522	623	164,708	1,243
Grand total			74,211	8,770	488,982	16,714

Table 66 Summary of AAFCUs within the Yazoo Study Area indirect impact area under the No Action Alternative

Function	Mature Forest	Agricultural	Total
Detain Floodwater	72,818	2,192	75,010
Detain Precipitation	61,402	4,933	66,335
Cycle Nutrients	70,522	2,558	73,080
Export Organic Carbon	51,926	1,562	53,488
Physical Removal of Elements and Compounds	43,023	3,906	46,929
Biological Removal of Elements and Compounds	51,926	1,562	53,488
Maintain Plant Communities	68,718	0	68,718
Provide Wildlife Habitat	68,647	0	68,647
Total	488,982	16,714	505,696

Table 67 Summary of AAFCUs provided in the direct and indirect impact areas under the No Action Alternative

Impact Area	Mature Forest	Agricultural	Total
Direct	394	50	444
Indirect	488,982	16,714	505,696
Total	489,376	16,765	506,141

Table 68 Change in AAFCUs across land cover classifications within the direct impact area under the Proposed Plan						
	Mature Forest					
	No Action Alternative			Action Alternative		
Function	FCI	Acres	AAFCU	Acres	AAFCU	Change in AAFCU
Detain Floodwater	0.98	59	58	0	0	-58
Detain Precipitation	0.83	59	49	0	0	-49
Cycle Nutrients	0.95	59	56	0	0	-56
Export Organic Carbon	0.74	59	43	0	0	-43
Physical Removal of Elements and Compounds	0.62	59	36	0	0	-36
Biological Removal of Elements and Compounds	0.74	59	43	0	0	-43
Maintain Plant Communities	0.93	59	55	0	0	-55
Provide Wildlife Habitat	0.93	59	55	0	0	-55
	Agricultural					
	No Action Alternative			Action Alternative		
Detain Floodwater	0.25	25	6	0	0	-6
Detain Precipitation	0.56	25	14	0	0	-14
Cycle Nutrients	0.29	25	7	0	0	-7
Export Organic Carbon	0.2	25	5	0	0	-5
Physical Removal of Elements and Compounds	0.49	25	12	0	0	-12
Biological Removal of Elements and Compounds	0.2	25	5	0	0	-5
Maintain Plant Communities	0	25	0	0	0	0
Provide Wildlife Habitat	0	25	0	0	0	0
Total			444		0	-444

Table 69 Projected changes in flood duration across wetland land cover classes in the indirect impact area under the Proposed Plan				
Flood duration interval (% of growing season)		Extent (acres)		
No Action Alternative	Proposed Plan	Mature Forest	Agricultural	Total
No change in flood duration				
5-7.5	5-7.5	1,079	179	1,257
7.5-10	7.5-10	8,624	1,061	9,685
10-12.5	10-12.5	10,469	458	10,927
>12.5	>12.5	21,824	513	22,337
Total		41,995	2,212	44,207
Decrease in flood duration				
5-7.5	0.0	43	7	50
5-7.5	0.0-2.5	5,230	1,110	6,340
5-7.5	2.5-5	14,901	3,887	18,788
7.5-10	0.0-2.5	179	1	180
7.5-10	2.5-5	1,239	345	1,584
7.5-10	5-7.5	3,840	786	4,626
10-12.5	5-7.5	2	0	2
10-12.5	7.5-10	4,083	313	4,396
>12.5	7.5-10	35	4	39
>12.5	10-12.5	2,664	106	2,769
Total		32,215	6,558	38,774
Grand total		74,211	8,770	82,981

Table 70 Change in AAFCUs for areas shifting from the 5.0-7.5% flood duration interval to the 0.0% flood duration interval under the Propsoed Plan					
Function	5.0-7.5% FCI	0.0% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.82	-0.16	43	-7
Detain Precipitation	0.83	0.83	0.00	43	0
Cycle Nutrients	0.95	0.95	0.00	43	0
Export Organic Carbon	0.64	0.26	-0.38	43	-17
Physical Removal of Elements and Compounds	0.53	0.22	-0.32	43	-14
Biological Removal of Elements and Compounds	0.64	0.26	-0.38	43	-17
Maintain Plant Communities	0.93	0.93	0.00	43	0
Provide Wildlife Habitat	0.92	0.84	-0.08	43	-3
Agricultural					
Detain Floodwater	0.25	0.21	-0.04	7	0
Detain Precipitation	0.56	0.56	0.00	7	0
Cycle Nutrients	0.29	0.29	0.00	7	0
Export Organic Carbon	0.17	0.07	-0.10	7	-1
Physical Removal of Elements and Compounds	0.43	0.17	-0.26	7	-2
Biological Removal of Elements and Compounds	0.17	0.07	-0.10	7	-1
Maintain Plant Communities	0.00	0.00	0.00	7	0
Provide Wildlife Habitat	0.00	0.00	0.00	7	0
Total				50	-61

Table 71 Change in AAFCUs for areas shifting from the 5.0-7.5% flood duration interval to the 0.0-2.5% flood duration interval under the Proposed Plan					
Function	5.0-7.5% FCI	0.0-2.5% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	5,230	0
Detain Precipitation	0.83	0.83	0.00	5,230	0
Cycle Nutrients	0.95	0.95	0.00	5,230	0
Export Organic Carbon	0.64	0.39	-0.25	5,230	-1,328
Physical Removal of Elements and Compounds	0.53	0.32	-0.21	5,230	-1,101
Biological Removal of Elements and Compounds	0.64	0.39	-0.25	5,230	-1,328
Maintain Plant Communities	0.93	0.93	0.00	5,230	0
Provide Wildlife Habitat	0.92	0.87	-0.04	5,230	-226
Agricultural					
Detain Floodwater	0.25	0.25	0.00	1,110	0
Detain Precipitation	0.56	0.56	0.00	1,110	0
Cycle Nutrients	0.29	0.29	0.00	1,110	0
Export Organic Carbon	0.17	0.10	-0.07	1,110	-75
Physical Removal of Elements and Compounds	0.43	0.26	-0.17	1,110	-188
Biological Removal of Elements and Compounds	0.17	0.10	-0.07	1,110	-75
Maintain Plant Communities	0.00	0.00	0.00	1,110	0
Provide Wildlife Habitat	0.00	0.00	0.00	1,110	0
Total				6,340	-4,322

Table 72 Change in AAFCUs for areas shifting from the 5.0-7.5% flood duration interval to the 2.5-5.0% flood duration interval under the Proposed Plan					
Function	5.0-7.5% FCI	2.5-5.0% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	14,901	0
Detain Precipitation	0.83	0.83	0.00	14,901	0
Cycle Nutrients	0.95	0.95	0.00	14,901	0
Export Organic Carbon	0.64	0.55	-0.10	14,901	-1,456
Physical Removal of Elements and Compounds	0.53	0.45	-0.08	14,901	-1,206
Biological Removal of Elements and Compounds	0.64	0.55	-0.10	14,901	-1,456
Maintain Plant Communities	0.93	0.93	0.00	14,901	0
Provide Wildlife Habitat	0.92	0.90	-0.02	14,901	-237
Agricultural					
Detain Floodwater	0.25	0.25	0.00	3,887	0
Detain Precipitation	0.56	0.56	0.00	3,887	0
Cycle Nutrients	0.29	0.29	0.00	3,887	0
Export Organic Carbon	0.17	0.15	-0.03	3,887	-101
Physical Removal of Elements and Compounds	0.43	0.36	-0.07	3,887	-253
Biological Removal of Elements and Compounds	0.17	0.15	-0.03	3,887	-101
Maintain Plant Communities	0.00	0.00	0.00	3,887	0
Provide Wildlife Habitat	0.00	0.00	0.00	3,887	0
Total				18,788	-4,810

Table 73 Change in AAFCUs for areas shifting from the 7.5-10% flood duration interval to the 0.0-2.5% flood duration interval under the Proposed Plan					
Function	7.5-10% FCI	0.0-2.5% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	179	0
Detain Precipitation	0.83	0.83	0.00	179	0
Cycle Nutrients	0.95	0.95	0.00	179	0
Export Organic Carbon	0.68	0.39	-0.29	179	-52
Physical Removal of Elements and Compounds	0.57	0.32	-0.24	179	-43
Biological Removal of Elements and Compounds	0.68	0.39	-0.29	179	-52
Maintain Plant Communities	0.93	0.93	0.00	179	0
Provide Wildlife Habitat	0.92	0.87	-0.05	179	-9
Agricultural					
Detain Floodwater	0.25	0.25	0.00	1	0
Detain Precipitation	0.56	0.56	0.00	1	0
Cycle Nutrients	0.29	0.29	0.00	1	0
Export Organic Carbon	0.18	0.10	-0.08	1	0
Physical Removal of Elements and Compounds	0.46	0.26	-0.20	1	0
Biological Removal of Elements and Compounds	0.18	0.10	-0.08	1	0
Maintain Plant Communities	0.00	0.00	0.00	1	0
Provide Wildlife Habitat	0.00	0.00	0.00	1	0
Total				180	-158

Table 74 Change in AAFCUs for areas shifting from the 7.5-10% flood duration interval to the 2.5-5.0% flood duration interval under the Proposed Plan					
Function	7.5-10% FCI	2.5-5.0% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	1,239	0
Detain Precipitation	0.83	0.83	0.00	1,239	0
Cycle Nutrients	0.95	0.95	0.00	1,239	0
Export Organic Carbon	0.68	0.55	-0.14	1,239	-169
Physical Removal of Elements and Compounds	0.57	0.45	-0.11	1,239	-140
Biological Removal of Elements and Compounds	0.68	0.55	-0.14	1,239	-169
Maintain Plant Communities	0.93	0.93	0.00	1,239	0
Provide Wildlife Habitat	0.92	0.90	-0.02	1,239	-27
Agricultural					
Detain Floodwater	0.25	0.25	0.00	345	0
Detain Precipitation	0.56	0.56	0.00	345	0
Cycle Nutrients	0.29	0.29	0.00	345	0
Export Organic Carbon	0.18	0.15	-0.04	345	-13
Physical Removal of Elements and Compounds	0.46	0.36	-0.09	345	-31
Biological Removal of Elements and Compounds	0.18	0.15	-0.04	345	-13
Maintain Plant Communities	0.00	0.00	0.00	345	0
Provide Wildlife Habitat	0.00	0.00	0.00	345	0
Total				1,584	-563

Table 75 Change in AAFCUs for areas shifting from the 7.5-10% flood duration interval to the 5.0-7.5% flood duration interval under the Proposed Plan					
Function	7.5-10% FCI	5.0-7.5% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	3,840	0
Detain Precipitation	0.83	0.83	0.00	3,840	0
Cycle Nutrients	0.95	0.95	0.00	3,840	0
Export Organic Carbon	0.68	0.64	-0.04	3,840	-150
Physical Removal of Elements and Compounds	0.57	0.53	-0.03	3,840	-124
Biological Removal of Elements and Compounds	0.68	0.64	-0.04	3,840	-150
Maintain Plant Communities	0.93	0.93	0.00	3,840	0
Provide Wildlife Habitat	0.92	0.92	-0.01	3,840	-24
Agricultural					
Detain Floodwater	0.25	0.25	0.00	786	0
Detain Precipitation	0.56	0.56	0.00	786	0
Cycle Nutrients	0.29	0.29	0.00	786	0
Export Organic Carbon	0.18	0.17	-0.01	786	-8
Physical Removal of Elements and Compounds	0.46	0.43	-0.03	786	-20
Biological Removal of Elements and Compounds	0.18	0.17	-0.01	786	-8
Maintain Plant Communities	0.00	0.00	0.00	786	0
Provide Wildlife Habitat	0.00	0.00	0.00	786	0
Total				4,626	-485

Table 76 Change in AAFCUs for areas shifting from the 10-12.5% flood duration interval to the 5.0-7.5% flood duration interval under the Proposed Plan					
Function	10-12.5% FCI	5.0-7.5% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	2	0.00
Detain Precipitation	0.83	0.83	0.00	2	0.00
Cycle Nutrients	0.95	0.95	0.00	2	0.00
Export Organic Carbon	0.72	0.64	-0.08	2	-0.16
Physical Removal of Elements and Compounds	0.60	0.53	-0.06	2	-0.13
Biological Removal of Elements and Compounds	0.72	0.64	-0.08	2	-0.16
Maintain Plant Communities	0.93	0.93	0.00	2	0.00
Provide Wildlife Habitat	0.93	0.92	-0.01	2	-0.02
Agricultural					
Detain Floodwater	0.25	0.25	0.00	0	0
Detain Precipitation	0.56	0.56	0.00	0	0
Cycle Nutrients	0.29	0.29	0.00	0	0
Export Organic Carbon	0.19	0.17	-0.02	0	0
Physical Removal of Elements and Compounds	0.48	0.43	-0.05	0	0
Biological Removal of Elements and Compounds	0.19	0.17	-0.02	0	0
Maintain Plant Communities	0.00	0.00	0.00	0	0
Provide Wildlife Habitat	0.00	0.00	0.00	0	0
Total				2	-0.47

Table 77 Change in AAFCUs for areas shifting from the 10-12.5% flood duration interval to the 7.5-10% flood duration interval under the Proposed Plan					
Function	10-12.5% FCI	7.5-10% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	4,083	0
Detain Precipitation	0.83	0.83	0.00	4,083	0
Cycle Nutrients	0.95	0.95	0.00	4,083	0
Export Organic Carbon	0.72	0.68	-0.04	4,083	-160
Physical Removal of Elements and Compounds	0.60	0.57	-0.03	4,083	-132
Biological Removal of Elements and Compounds	0.72	0.68	-0.04	4,083	-160
Maintain Plant Communities	0.93	0.93	0.00	4,083	0
Provide Wildlife Habitat	0.93	0.92	-0.01	4,083	-25
Agricultural					
Detain Floodwater	0.25	0.25	0.00	313	0
Detain Precipitation	0.56	0.56	0.00	313	0
Cycle Nutrients	0.29	0.29	0.00	313	0
Export Organic Carbon	0.19	0.18	-0.01	313	-3
Physical Removal of Elements and Compounds	0.48	0.46	-0.03	313	-8
Biological Removal of Elements and Compounds	0.19	0.18	-0.01	313	-3
Maintain Plant Communities	0.00	0.00	0.00	313	0
Provide Wildlife Habitat	0.00	0.00	0.00	313	0
Total				4,396	-491

Table 78 Change in AAFCUs for areas shifting from the >12.5% flood duration interval to the 7.5-10% flood duration interval under the Proposed Plan					
Function	>12.5% FCI	7.5-10% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	35	0
Detain Precipitation	0.83	0.83	0.00	35	0
Cycle Nutrients	0.95	0.95	0.00	35	0
Export Organic Carbon	0.74	0.68	-0.06	35	-2
Physical Removal of Elements and Compounds	0.62	0.57	-0.05	35	-2
Biological Removal of Elements and Compounds	0.74	0.68	-0.06	35	-2
Maintain Plant Communities	0.93	0.93	0.00	35	0
Provide Wildlife Habitat	0.93	0.92	-0.01	35	0
Agricultural					
Detain Floodwater	0.25	0.25	0.00	4	0
Detain Precipitation	0.56	0.56	0.00	4	0
Cycle Nutrients	0.29	0.29	0.00	4	0
Export Organic Carbon	0.20	0.18	-0.02	4	0
Physical Removal of Elements and Compounds	0.49	0.46	-0.04	4	0
Biological Removal of Elements and Compounds	0.20	0.18	-0.02	4	0
Maintain Plant Communities	0.00	0.00	0.00	4	0
Provide Wildlife Habitat	0.00	0.00	0.00	4	0
Total				39	-6

Table 79 Change in AAFCUs for areas shifting from the >12.5% flood duration interval to the 10-12.5% flood duration interval under the Proposed Plan					
Function	>12.5% FCI	10-12% FCI	Change in FCI	Extent (acres)	Change in AAFCU
Mature Forest					
Detain Floodwater	0.98	0.98	0.00	2,664	0
Detain Precipitation	0.83	0.83	0.00	2,664	0
Cycle Nutrients	0.95	0.95	0.00	2,664	0
Export Organic Carbon	0.74	0.72	-0.02	2,664	-52
Physical Removal of Elements and Compounds	0.62	0.60	-0.02	2,664	-43
Biological Removal of Elements and Compounds	0.74	0.72	-0.02	2,664	-52
Maintain Plant Communities	0.93	0.93	0.00	2,664	0
Provide Wildlife Habitat	0.93	0.93	0.00	2,664	-8
Agricultural					
Detain Floodwater	0.25	0.25	0.00	106	0
Detain Precipitation	0.56	0.56	0.00	106	0
Cycle Nutrients	0.29	0.29	0.00	106	0
Export Organic Carbon	0.20	0.19	-0.01	106	-1
Physical Removal of Elements and Compounds	0.49	0.48	-0.01	106	-1
Biological Removal of Elements and Compounds	0.20	0.19	-0.01	106	-1
Maintain Plant Communities	0.00	0.00	0.00	106	0
Provide Wildlife Habitat	0.00	0.00	0.00	106	0
Total				2,770	-158

Table 80 Summary of changes in AAFCUs across wetland land cover classes in the indirect impact area under the Proposed Plan				
Flood duration interval (% of growing season)		Change in AAFCUs		
No Action Alternative	Action Alternative	Mature Forest	Agricultural	Total
5-7.5	0.0	-57	-4	-61
5-7.5	0.0-2.5	-3,984	-338	-4,322
5-7.5	2.5-5	-4,355	-456	-4,810
7.5-10	0.0-2.5	-157	0	-158
7.5-10	2.5-5	-507	-57	-563
7.5-10	5-7.5	-448	-37	-485
10-12.5	5-7.5	-0.47	0	-0.47
10-12.5	7.5-10	-476	-15	-491
>12.5	7.5-10	-6	0	-6
>12.5	10-12.5	-155	-2	-157
Total		-10,145	-908	-11,054

Table 81. Summary of land cover classes and AAFCUs changes within the Yazoo Study Area under the No Action and the Proposed Plan						
Direct impacts						
Land cover	No Action Alternative		Proposed Plan		Change	
	Acres	AAFCU	Acres	AAFCU	Acres	AAFCU
Mature Forests	59	398	0	0	-59	-398
Agricultural	25	46	0	0	-25	-46
Non-Wetlands	206	0	290	0	87	0
Subtotal						-444
Indirect impacts						
Land cover	No Action Alternative		Proposed Plan		Change	
	Acres	AAFCU	Acres	AAFCU	Acres	AAFCU
Mature Forests	74,221	488,982	74,221	478,837	0	-10145
Agricultural	8,770	16,714	8,770	15,806	0	-908
Non-Wetlands	14,696	0	14,696	0	0	0
Subtotal						-11054
Total impacts						
Land cover	No Action Alternative		Proposed Plan		Change	
	Acres	AAFCU	Acres	AAFCU	Acres	AAFCU
Mature Forests	74,280	489,380	74,221	478,837	-59	-10,544
Agricultural	8,795	16,760	8,770	15,806	-25	-954
Non-Wetlands	14,902	0	14,986	0	87	0
Total change in AAFCUs resulting from the Proposed Plan						-11,498

Table 82 Determination of compensatory mitigation required to offset both direct and indirect impacts									
Target Year	FCI	Acres	FCU	FCU between years	Target Year	FCI	Acres	FCU	FCU between years
Detain Floodwater					Physical Removal of Elements and Compounds				
0	0.08	2,405	192		0	0.56	2,405	1,347	
5	0.23	2,405	553	1,864	5	0.56	2,405	1,347	6,734
10	0.4	2,405	962	3,788	10	0.56	2,405	1,347	6,734
20	0.53	2,405	1,275	11,183	20	0.56	2,405	1,347	13,468
35	0.61	2,405	1,467	20,563	35	0.56	2,405	1,347	20,202
50	0.65	2,405	1,563	22,727	50	0.56	2,405	1,347	20,202
Sum over 50 years				60,125	Sum over 50 years				67,340
AAFCU				1,203	AAFCU				1,347
Detain Precipitation					Biological Removal of Elements & Compounds				
0	0.75	2,405	1,804		0	0.09	2,405	216	
5	0.81	2,405	1,948	9,380	5	0.18	2,405	433	1,623
10	0.8	2,405	1,924	9,680	10	0.23	2,405	553	2,465
20	0.82	2,405	1,972	19,481	20	0.26	2,405	625	5,892
35	1	2,405	2,405	32,828	35	0.48	2,405	1,154	13,348
50	1	2,405	2,405	36,075	50	0.48	2,405	1,154	17,316
Sum over 50 years				107,443	Sum over 50 years				40,645
AAFCU				2,149	AAFCU				813
Cycle Nutrients					Maintain Plant Communities				
0	0.27	2,405	649		0	0	2,405	0	
5	0.41	2,405	986	4,089	5	0.58	2,405	1,395	3,487
10	0.49	2,405	1,178	5,411	10	0.7	2,405	1,684	7,696
20	0.54	2,405	1,299	12,386	20	0.88	2,405	2,116	19,000
35	0.89	2,405	2,140	25,794	35	0.94	2,405	2,261	32,828
50	0.9	2,405	2,165	32,287	50	0.97	2,405	2,333	34,452
Sum over 50 years				79,966	Sum over 50 years				97,463
AAFCU				1,599	AAFCU				1,949
Export Organic Carbon					Provide Wildlife Habitat				
0	0.09	2,405	216		0	0	2,405	0	
5	0.18	2,405	433	1,623	5	0.48	2,405	1,154	2,886
10	0.23	2,405	553	2,465	10	0.54	2,405	1,299	6,133
20	0.26	2,405	625	5,892	20	0.64	2,405	1,539	14,190
35	0.48	2,405	1,154	13,348	35	0.86	2,405	2,068	27,056
50	0.48	2,405	1,154	17,316	50	0.86	2,405	2,068	31,025
Sum over 50 years				40,645	Sum over 50 years				81,289
AAFCU				813	AAFCU				1,626
Total AAFCUs generated by 2,405 acres of mitigation									11,498

Table 83 Determination of compensatory mitigation required to offset direct impacts									
Target Year	FCI	Acres	FCU	FCU between years	Target Year	FCI	Acres	FCU	FCU between years
Detain Floodwater					Physical Removal of Elements and Compounds				
0	0.08	93	7		0	0.56	93	52	
5	0.23	93	21	72	5	0.56	93	52	260
10	0.4	93	37	146	10	0.56	93	52	260
20	0.53	93	49	432	20	0.56	93	52	521
35	0.61	93	57	795	35	0.56	93	52	781
50	0.65	93	60	879	50	0.56	93	52	781
Sum over 50 years				2,325	Sum over 50 years				2,604
AAFCU				47	AAFCU				52
Detain Precipitation					Biological Removal of Elements & Compounds				
0	0.75	93	70		0	0.09	93	8	
5	0.81	93	75	363	5	0.18	93	17	63
10	0.8	93	74	374	10	0.23	93	21	95
20	0.82	93	76	753	20	0.26	93	24	228
35	1	93	93	1,269	35	0.48	93	45	516
50	1	93	93	1,395	50	0.48	93	45	670
Sum over 50 years				4,155	Sum over 50 years				1,572
AAFCU				83	AAFCU				31
Cycle Nutrients					Maintain Plant Communities				
0	0.27	93	25		0	0	93	0	
5	0.41	93	38	158	5	0.58	93	54	135
10	0.49	93	46	209	10	0.7	93	65	298
20	0.54	93	50	479	20	0.88	93	82	735
35	0.89	93	83	997	35	0.94	93	87	1,269
50	0.9	93	84	1,249	50	0.97	93	90	1,332
Sum over 50 years				3,092	Sum over 50 years				3,769
AAFCU				62	AAFCU				75
Export Organic Carbon					Provide Wildlife Habitat				
0	0.09	93	8		0	0	93	0	
5	0.18	93	17	63	5	0.48	93	45	112
10	0.23	93	21	95	10	0.54	93	50	237
20	0.26	93	24	228	20	0.64	93	60	549
35	0.48	93	45	516	35	0.86	93	80	1,046
50	0.48	93	45	670	50	0.86	93	80	1,200
Sum over 50 years				1,572	Sum over 50 years				3,143
AAFCU				31	AAFCU				63
Total AAFCUs generated by 93 acres of mitigation									444

Table 84 Determination of compensatory mitigation required to offset indirect impacts									
Target Year	FCI	Acres	FCU	FCU between years	Target Year	FCI	Acres	FCU	FCU between years
Detain Floodwater					Physical Removal of Elements and Compounds				
0	0.08	2,312	185		0	0.56	2,312	1,295	
5	0.23	2,312	532	1,792	5	0.56	2,312	1,295	6,475
10	0.4	2,312	925	3,642	10	0.56	2,312	1,295	6,475
20	0.53	2,312	1,226	10,753	20	0.56	2,312	1,295	12,949
35	0.61	2,312	1,411	19,771	35	0.56	2,312	1,295	19,424
50	0.65	2,312	1,503	21,852	50	0.56	2,312	1,295	19,424
Sum over 50 years				57,810	Sum over 50 years				64,747
AAFCU				1,156	AAFCU				1,295
Detain Precipitation					Biological Removal of Elements & Compounds				
0	0.75	2,312	1,734		0	0.09	2,312	208	
5	0.81	2,312	1,873	9,018	5	0.18	2,312	416	1,561
10	0.8	2,312	1,850	9,307	10	0.23	2,312	532	2,370
20	0.82	2,312	1,896	18,730	20	0.26	2,312	601	5,665
35	1	2,312	2,312	31,564	35	0.48	2,312	1,110	12,834
50	1	2,312	2,312	34,686	50	0.48	2,312	1,110	16,649
Sum over 50 years				103,306	Sum over 50 years				39,080
AAFCU				2,066	AAFCU				781
Cycle Nutrients					Maintain Plant Communities				
0	0.27	2,312	624		0	0	2,312	0	
5	0.41	2,312	948	3,931	5	0.58	2,312	1,341	3,353
10	0.49	2,312	1,133	5,203	10	0.7	2,312	1,619	7,400
20	0.54	2,312	1,249	11,909	20	0.88	2,312	2,035	18,268
35	0.89	2,312	2,058	24,800	35	0.94	2,312	2,174	31,564
50	0.9	2,312	2,081	31,044	50	0.97	2,312	2,243	33,125
Sum over 50 years				76,887	Sum over 50 years				93,710
AAFCU				1,538	AAFCU				1,874
Export Organic Carbon					Provide Wildlife Habitat				
0	0.09	2,312	208		0	0	2,312	0	
5	0.18	2,312	416	1,561	5	0.48	2,312	1,110	2,775
10	0.23	2,312	532	2,370	10	0.54	2,312	1,249	5,897
20	0.26	2,312	601	5,665	20	0.64	2,312	1,480	13,643
35	0.48	2,312	1,110	12,834	35	0.86	2,312	1,989	26,015
50	0.48	2,312	1,110	16,649	50	0.86	2,312	1,989	29,830
Sum over 50 years				39,080	Sum over 50 years				78,159
AAFCU				781	AAFCU				1,563
Total AAFCUs generated by 2312 acres of mitigation									11,054

Table 85 Comparison of wetland assessment results from the 2007 FSEIS and the current report. *Note the 2007 FEIS report described direct impacts related to a pump station located near Steele Bayou, while the Proposed Plan described conditions for a pump station located near Deer Creek		
	2007 FSEIS	Current analysis
Direct impacts - *pump station and borrow areas		
Wetland acres (≥5.0% duration)	38	84
No Action Alternative AAFCUs	240	444
Action Alternative AAFCUs	0	0
Change in AAFCUs	-240	-444
Compensatory mitigation (acres)	64	93
Indirect impacts - reduction in flood duration		
Wetland acres (≥5.0% duration)	189,600	82,981
Wetland acres that would not shift flood duration change in flood duration under the Action alternative	122,600	44,207
Wetland acres that would shift flood duration change in flood duration under the Action alternative	67,000	38,774
No Action Alternative AAFCUs	885,300	505,696
Action Alternative AAFCUs	870,900	494,643
Total change in AAFCUs	-14,400	-11,054
Compensatory mitigation (acres)	3,800	2,312
Total impacts		
Wetland acres (≥5.0% duration)	189,638	83,065
No Action Alternative AAFCUs	885,540	506,140
Action Alternative AAFCUs	870,900	494,643
Change in AAFCUs	-14,640	-11,498
Compensatory mitigation (acres)	3,864	2,405

Table 86 Determination of nonstructural AAFCUs across target years for each wetland function									
Target Year	FCI	Acres	FCU	FCU between years	Target Year	FCI	Acres	FCU	FCU between years
Detain Floodwater					Physical Removal of Elements and Compounds				
0	0.08	2,700	225		0	0.22	2,700	600	
5	0.23	2,700	611	2,091	5	0.22	2,700	600	3,000
10	0.40	2,700	1,089	4,250	10	0.22	2,700	600	3,000
20	0.53	2,700	1,426	12,571	20	0.22	2,700	600	6,000
35	0.61	2,700	1,659	23,136	35	0.22	2,700	600	9,000
50	0.65	2,700	1,744	25,522	50	0.22	2,700	600	9,000
Sum over 50 years				67,569	Sum over 50 years				29,999
AAFCU				1,351	AAFCU				600
Detain Precipitation					Biological Removal of Elements & Compounds				
0	0.75	2,700	2,025		0	0.04	2,700	100	
5	0.81	2,700	2,180	10,513	5	0.07	2,700	197	744
10	0.80	2,700	2,153	10,834	10	0.09	2,700	248	1,115
20	0.82	2,700	2,214	21,836	20	0.10	2,700	278	2,633
35	1.00	2,700	2,700	36,855	35	0.19	2,700	515	5,950
50	1.00	2,700	2,700	40,500	50	0.19	2,700	519	7,758
Sum over 50 years				120,538	Sum over 50 years				18,199
AAFCU				2,411	AAFCU				364
Cycle Nutrients					Maintain Plant Communities				
0	0.27	2,700	731		0	0.00	2,700	0	
5	0.41	2,700	1,098	4,573	5	0.58	2,700	1,560	3,900
10	0.49	2,700	1,328	6,063	10	0.70	2,700	1,886	8,615
20	0.54	2,700	1,447	13,872	20	0.90	2,700	2,422	21,544
35	0.89	2,700	2,414	28,954	35	0.94	2,700	2,543	37,239
50	0.90	2,700	2,427	36,308	50	0.97	2,700	2,609	38,638
Sum over 50 years				89,769	Sum over 50 years				109,935
AAFCU				1,795	AAFCU				2,199
Export Organic Carbon					Provide Wildlife Habitat				
0	0.04	2,700	100		0	0.00	2,700	0	
5	0.07	2,700	197	744	5	0.41	2,700	1,118	2,796
10	0.09	2,700	248	1,115	10	0.47	2,700	1,266	5,962
20	0.10	2,700	278	2,633	20	0.56	2,700	1,522	13,944
35	0.19	2,700	515	5,950	35	0.75	2,700	2,023	26,588
50	0.19	2,700	519	7,758	50	0.75	2,700	2,023	30,341
Sum over 50 years				18,199	Sum over 50 years				79,630
AAFCU				364	AAFCU				1,593
Total increase in AAFCUs as a result of the nonstructural component									10,677

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